User revealment revisited

Knowledge formation in the prefocus stage of information-based work tasks

Seland, Grete

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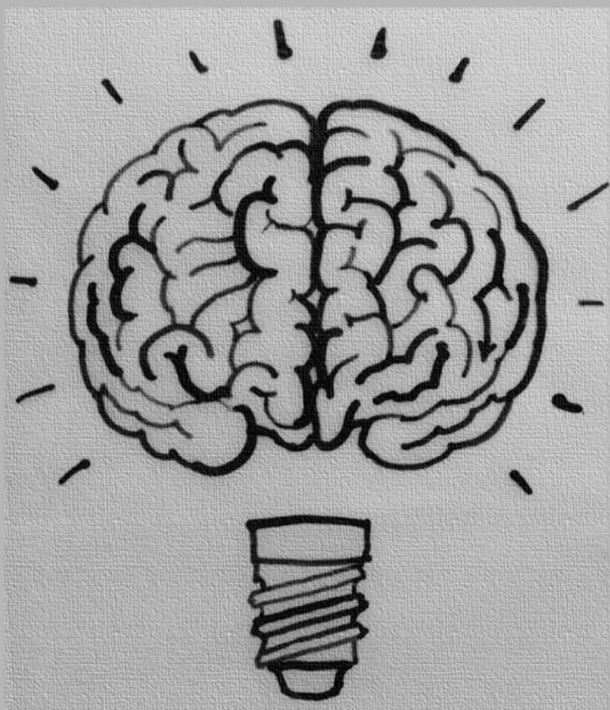

Thesis submitted for the degree of PhD
Faculty of Humanities
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Learning begins
with uncertainty
and is driven by
the desire to seek
meaning.

Carol C. Kuhlthau

Abstract

In this study I address the following three questions: How do students formulate their information needs in the early stage of their information-based work tasks? How can students benefit from their teachers' terminological competence? How do students' learning styles affect their formulation behaviour?

The aim of this thesis has been to investigate how students gradually become more aware of their information needs during their work task process, specifically during the prefocus stage, before they have formulated a topical focus. The process of students clarifying their information needs was called *cognitive user revealment*. It was explored whether – and how – students might benefit from teachers' terminological understanding of a topical area, as well as how students' learning styles affect their formulation behaviour. The research topic has been explored with an interdisciplinary perspective, using information searching theory, cognitive linguistic theory, and cognitive psychological theory.

Elaborating information needs is a process of knowledge formation in which students have to activate their vocabulary and relate new ideas to their own current knowledge. This involves the handling of information which is not yet integrated as meaningful knowledge, due to the 'knowledge gap' actualized by the task requirements. An increased understanding of students' information need formulation behaviour has consequences for system design, as well as information literacy training.

An associative semantic network of pedagogic terminology was compiled from teachers' word associations and descriptions of relationships between word pairs. This tool was used in a one-hour laboratory test session with students from educational science, elaborating on an assigned work task in several terminological steps. The students organized their work tasks and arrived at tentative search terms – first on their own, and afterwards using the associative semantic database compiled for this study.

The outcome of the analysis shows that students benefit from using a semantic tool in the prefocus stage of their work tasks, as a trigger for the activation and enrichment of their own knowledge. This is especially true for students with a *deep* learning style, who exhibit an ability to formulate their work tasks with a rich vocabulary, also on their own. For a semantic tool to be useful in the prefocus stage, students have to acquire learning strategies characterized by a thoroughness in the way they approach the work task process. This includes terminological elaboration of their information needs prior to search system interaction.

The results of the analysis have been discussed in light of the digital learning context of 'the Google generation'. A semantic tool of the kind piloted in this study should be available on the digital platforms students apply, and be used in bridging the gap between the students' own vocabulary and the terminology used in information available on the Web.

In relation to the research questions, the findings can be summarized as: The variation in students' formulation of information needs is related to prior knowledge of the work task, degree of deep learning style, and previous studies in pedagogy. Most students benefit from their teachers' terminological competence by using an associative semantic tool in the prefocus stage of their work tasks for enriching their own brainstorm. Students with a high degree of deep learning style also used the semantic tool in the revision of search term candidates – either as a trigger in the reactivation of their own vocabulary, or as an input for new tentative search terms. When students with a high degree of deep learning style select many terms from the semantic tool in the reformulation of tentative search terms, they have already exhibited a large self-produced vocabulary on their own.

Activated current knowledge enhances students' abilities in information need formulation. This can be stimulated by the use of associative semantic tools, as well as by an increased digital literacy among students.

Key words: information needs, information searching, information behaviour, learning styles.

Norwegian summary

I denne avhandlingen tar jeg opp følgende tre spørsmål: Hvordan formulerer studenter informasjonsbehovene sine i den tidlige fasen av informasjonsbaserte arbeidsoppgaver? Hvordan kan studenter dra nytte av sine læreres terminologiske kompetanse? Hvordan påvirker studentenes læringsstiler måten de formulerer seg på?

Formålet med denne avhandlingen har vært å undersøke hvordan studenter gradvis blir mer bevisste på sitt informasjonsbehov i forbindelse med arbeidsoppgaver de jobber med på studiet, spesielt i løpet av den utforskende fasen, før de har formulert et fokus. I avhandlingen har denne bearbeidingsprosessen hos studentene blitt kalt *brukeres kognitive avklaring* av informasjonsbehov. I den empiriske studien ble det undersøkt om – og hvordan – studenter kan ha nytte av den terminologiske forståelsen som lærerne deres har av et fagområde. Dessuten har det blitt undersøkt hvordan studentenes læringsstiler virker inn på måten de formulerer seg. Temaet for avhandlingen har blitt studert i et tverrfaglig perspektiv, ved hjelp av teori om informasjonssøkeatferd, kognitiv lingvistisk teori, samt kognitiv psykologisk teori.

Prosessen med å bearbeide informasjonsbehov forutsetter en kunnskapsdannelse hos studentene, der de må aktivere ordforrådet sitt og relatere nye ideer til den eksisterende kunnskapen de har. Dette innebærer at de må håndtere informasjon som ennå ikke er integrert som betydningsbærende kunnskap hos dem, på grunn av det «kunnskapshullet» som har blitt aktualisert i forbindelse med arbeidsoppgaven de har blitt tildelt. En økt forståelse av studentenes formuleringsatferd i forbindelse med at de bearbeider informasjonsbehov, har konsekvenser for utarbeiding av brukergrensesnitt, samt for opplæring i informasjonskompetanse.

I forbindelse med den empiriske studien ble det utarbeidet et assosiativt semantisk nettverk bestående av pedagogisk terminologi, basert på læreres ordassosiasjoner og beskrivelser av relasjoner mellom ordpar. Dette verktøyet ble brukt i en strukturert informantsesjon med studenter fra lærerutdanningen, der informantene i stikkordsform – og i flere omganger – bearbeidet den oppgaven de fikk tildelt. Studentene organiserte arbeidsoppgaven og foreslo søketermer – først på egenhånd, og deretter med bruk av den assosiative semantiske databasen som ble laget i forbindelse med undersøkelsen.

Analysen viser at studentene har utbytte av å bruke et semantisk verktøy i den utforskende fasen av arbeidet med studieoppgaver, som en trigger for aktivering og berikelse av egen kunnskap. Dette gjelder spesielt for studenter som har en såkalt *dyp* læringsstil, som viser en evne til å formulere arbeidsoppgavene sine med et rikt ordforråd, også på egenhånd. For at et semantisk verktøy skal være nyttig i den tidlige fasen av arbeidsoppgaver i forbindelse med studiet, må studentene etablere læringsstrategier som er preget av en grundighet i måten de nærmer seg oppgaveprosessen på. Dette inkluderer terminologisk bearbeiding av informasjonsbehov før man går i gang med interaktiv søking.

Resultatene av analysen er blitt beskrevet i lys av den digitale læringskonteksten som er typisk for 'Google-generasjonen'. Et semantisk verktøy av den typen som er testet i denne studien bør være tilgjengelig på de digitale plattformene som studenter allerede er fortrolige med, og det bør brukes til å bygge bro mellom studentenes eget vokabular og terminologien som brukes i den informasjonen som er tilgjengelig på nettet.

I forhold til forskningsspørsmålene, kan resultatene oppsummeres slik: Variasjonen i studentens formulering av informasjonsbehov er knyttet til om de har tidligere kjennskap til den aktuelle arbeidsoppgaven, graden av dyp læringsstil, samt hvorvidt de har gjennomført tidligere studier i pedagogikk. De fleste studentene drar nytte av lærernes terminologiske kompetanse ved å bruke det assosiative semantiske verktøyet i den utforskende fasen til å berike sin egen idédugnad for oppgaven. Studenter som har en sterk grad av dyp læringsstil brukte også det semantiske verktøyet til å revidere de tentative søketermene. Når studenter med en sterk grad av dyp læringsstil velger ut mange ord fra den semantiske verktøyet i til å omformulere settet av tentative søketermer, har de allerede utvist en evne til å produsere et stort ordforråd på egenhånd.

Aktivering av ens egen eksisterende kunnskap bedrer studentenes evne til å formulere informasjonsbehov. Dette kan stimuleres ved bruk av assosiative semantiske verktøy, samt ved en styrking av studentenes digitale kompetanse.

Stikkord: informasjonsbehov, informasjonssøking, informasjonsatferd, læringsstiler.

Acknowledgements

This PhD thesis would not have been possible without the support, advice, and encouragement from many persons. I want to take this opportunity to express my gratitude.

First and foremost I would like to thank my supervisor, Prof. Marianne Lykke (Aalborg University), and my co-supervisor Prof. Kristian Emil Kristoffersen (University of Oslo) who have guided me through a demanding process. It has been a privilege to have access to your professional skills, research experience, and attentive behaviour. Thank you both so very much. I am grateful for the welcoming attitude I have found at the Department of Communication and Psychology at Aalborg University when I approached Prof. Ellen Christiansen – the leader of the Human Centered Communication and Informatics-programme – with a request to complete my PhD studies with them, and to defend my thesis at their department.

I have undertaken my PhD project with an employment at the Department of Archivistics, Library and Information science at Oslo and Akershus University College of Applied Sciences (OAUC), funded with a grant from the Ministry of Education and Research. My PhD student affiliation has been at my supervisor Marianne's department at Aalborg University, and – before that – at the Royal School of Library and Information Science at the University of Copenhagen. In an early stage of this project – before my two maternity leaves – I was affiliated to Tampere University. I was then supervised by Prof. Eero Sormunen, with co-supervision from Prof. Rolf Theil (University of Oslo) – thank you both for your contribution. During one of my stays in Tampere, I was lucky to meet Prof. Marcia Bates who provided me with useful response on my project which was then in an early stage. I am much inspired by her approach to the research field of information searching.

During my years as a PhD student and lecturer at OAUC in Oslo, I have had the advantage of having a very competent Head of Studies – during the first years, Inger Cathrine Spangen, who encouraged me to undertake my PhD studies – and in later years Liv Gjestrum – you are both so full of support. I also want to thank my other colleagues at OAUC. I have had many useful discussions with Prof. Ragnar Nordlie throughout the process, and benefited greatly from his comments on early drafts of parts of my thesis. Ragnar even let me use his concept of *user revealment* in my own way. Special thanks goes to Assoc. Prof. Michael Preminger who compiled the necessary programming for the SQL structure which I needed to establish the PedNett database, which I used in the empirical study. I am greatly indebted to you, Michael, and I find you a superb collaborator. ICT-consultant Kjetil Iseli has also been a great help in technical matters. Thanks also to Assoc. Prof. Gunhild Salvesen, Assoc. Prof. Sunniva Evjen, Assis. Prof. Marit Kristine Ådland and my other colleagues and co-PhD-students for sharing joys and challenges of the PhD process, as well as teaching obligations.

My empirical study was performed during the spring term 2009 with students and teachers recruited from the Faculty of Education and International Studies at OAUC. Without their participation as informants, this project would not have been possible. Special thanks are due to Assoc. Prof. Hanne Christensen, Prof. Harald Jarning, and Assoc. Prof. Elisabeth Bjørnestad. They agreed to let me conduct the student informant sessions as an integrated part of their scheduled lectures in pedagogy, which secured me with sufficient student informants.

In 2011, I spent the spring term at my co-supervisor Kristian's Department of Linguistics and Scandinavian studies at the University of Oslo. I am grateful for the ability to discuss my project with the Cognitive Linguistic research group at the University of Oslo. Special thanks goes to Assoc. Prof. Bjørghild Kjelsvik who gave me comments on an early draft of the theoretical framework.

I appreciate without reservation the support I have met from my family and friends all these years. For me, undertaking a PhD project side by side with raising children has been possible only due to my husband Helge's dedicated efforts as a companion in life and as a great father for our lovely boys, Øystein and Audun. Much gratitude also goes to my sister Sigvor and my friend Karen for helping out with the children, and being such great 'think-aloud partners' in many matters. Karen's creativity brought about the front cover design with the 'revealed mind'. You even let me stay in your flat on several occasions when I needed some intense writing periods in the last stages of my PhD project. I am grateful to Helen for our longstanding friendship. The music of Bach, Beethoven & Mozart has been therapeutic for me – not as escapism, but as a meditative way to clear my head – so thanks are due to the old masters.

I have lived with this PhD project for a long time. The impetus for the project came from my curiosity concerning the challenging task of formulating 'what you do not know' when one is faced with a knowledge gap. I have a personal motivation for this topic. As a librarian I have experienced how information searchers often find it difficult to come up with adequate search terms to represent their information need. As a linguist I experience that people are able to access more and better words to express themselves, if their current knowledge on a given topic is already activated. Throughout my PhD project I have tried to get an informed opinion about how students can prepare themselves for more successful information searching. My findings suggest that students benefit from activating their current knowledge expressed with their own vocabulary before they start searching and are confronted with massive search results which they have to consider with respect to relevance. I am forever grateful for the opportunity I have had in conducting a PhD project to pursue my curiosity on these matters. I love to learn.

While I am grateful to so many who helped me with this thesis, I alone am responsible for all its shortcomings.

This thesis is dedicated to my supervisors Marianne and Kristian with gratitude, to my husband Helge with love, and to our children Øystein and Audun with enthusiasm for the way you constantly keep me in touch with the reality beyond user revealment!

Grete Seland, Oslo/Aalborg, June 2014

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Introduction

1.1 Purpose of the research

This thesis is engaged with students' clarification of information needs. The aim of my PhD project is to empirically explore how students elaborate their information needs in the prefocus exploration stage, which is an essential part of information-based work tasks. I will use the concept of *information-based work tasks* in line with Cole (2012) to refer to the kind of *work tasks* in which the user is faced with information needs, typically student assignments.[1] In the prefocus stage, the students experience feelings of confusion, frustration, and doubt, when they struggle with the exploration of vague information needs in an early stage of their work tasks (cf. Kuhlthau 2004 and section 2.2.1). Knowledge about students' information need formulation behaviour can in turn be used to develop built-in features in searching systems which can help people in their query formulations. Accordingly, I want to merge my empirical results about students' formulation behaviour with recent research concerning information seeking, in a discussion of implications for information system design. Findings concerning students' elaboration of information needs will also have implications for information literacy training.

Students learn by building on what they already know (Kuhlthau, Maniotes & Caspari 2007). The point of departure for all learning should be the students' current knowledge and their way of conceptualizing the world (Imsen 2005). Thus, before searching for information, students would benefit from activating what they already know on a topic in question. This may seem as an obvious statement, but for many students born in 'the Google generation',

[1] Several of the researchers I will refer to (e.g., Borlund (2000), Byström (2002), and Kuhlthau (2004)) use the wider notion *work task*. In the context if this thesis, however, *work task* and *information-based work task* are used synonymously, to refer to student assignments which involve the elaboration of information needs.

there is no intermediate stage between acquiring an information need and searching for information (Beheshti & Large 2013; Nicholas & Clark 2013). For these students, there is no such thing as a ‘presearch stage’ in which they actively ask themselves ‘what do I know about this topic’, or ‘what do I *not* know, and how can I formulate my knowledge gap’.

Many young students are online all along. From the moment they get an information need, they have their mobile devices available enabling them to be in a search process during all the stages of their information-based work tasks. So there is no separate ‘information collection’ stage for most students today – the search task (which is a part of the information-based work task) can be distributed on all the work-task stages. In topic selection, prefocus exploration and all the other sub-parts of information-based work tasks, many students have immediate access to the Internet through their smartphones, iPads, and laptops. According to Nicholas & Clark (2013), mobile users are the fastest-growing user community on the Web, and mobile devices will soon be the main platform for searching. Web searches performed with mobile devices are different from searches performed from desktops: “Mobile visits are information ‘lite’: typically shorter, less interactive, and with less content viewed per visit” (Nicholas & Clark 2013:240).

However, this is not the whole picture. Information needs are of all kinds, and even though mobile searching increases, this does not imply that users might have other searching strategies for more complex tasks – e.g., in relation to student assignments. Many information professionals maintain that information literacy training is still essential for students: “The Internet has become an integral part of all aspects of the life of twenty-first-century learners. Yet research shows that students’ ease and familiarity with the mechanics of the medium are not matched by their ability to evaluate electronic sources critically” Mandalios (2013:470). Mandalios cites researchers who already before the turn of the millennium claimed that if students growing up with digital media are going to be information literate, then teachers and librarians must stop assuming that students know how to search for information, or that students easily can learn searching skills without any intervention. In this thesis I will apply UNESCO’s definition of information literacy:

> Information Literacy lies at the core of lifelong learning. It empowers people in all walks of life to seek, evaluate, use and create information effectively to achieve their personal, social, occupational and educational goals. It is a basic human right in a digital world and promotes social inclusion of all nations. [...] Information literacy comprises the competencies to recognize information needs and to locate, evaluate, apply and create information within cultural and social contexts. UNESCO (2005)

What are the implications on students’ information need elaboration if they confront themselves with millions of hits from Web searching before they have formulated their own work task focus? How does this constant input of new information influence their knowledge formation process? Though I find these questions intriguing, I use them only as a background context for my own point of departure. My aim is not to study how students behave when they 'swim in an ocean of hits' throughout their work tasks. Rather, I want to study how students working with information-based work tasks can express their current knowledge in their own vocabulary, *before* they go searching for new information. The underlying assumption is that students can benefit from this activation process, because it enables them to access more and better words to express their information needs (Bybee 2010; Jackendoff 2002). With a good grip of their own vocabulary, students will be better prepared for handling massive input of search hits, because they can relate the new information to their current knowledge.

But do the students *need* any help in formulating their information needs? Indeed they do, as previous and present research indicates. For students to be able to acquire new knowledge, they have to formulate search terms which can lead them to the information they are missing. The antagonism between having a *knowledge gap* and the need to express 'what you do not know' has been thoroughly debated in the literature for a long time (Bates 1977; Belkin, Oddy & Brooks 1982a, 1982b; Fidel 199a, 1991b, 1991c; Ingwersen 1992, 1996; Nordlie 2000; Oddy 1977; Vakkari 2000; Vakkari, Pennanen & Serola 2003). Users of information systems have difficulties formulating appropriate search terms or finding alternative search terms if their original terms prove unsuccessful. This problem has not disappeared with new technology (Beheshti & Large 2013; Devine & Egger-Sider 2014; Gunter, Rowlands, & Nicholas 2009; White & Iivonen 2002).

Digital access does not implicate successful retrieval, if the users are not able to *express* what they need. Today's technology might have made librarians of us all when it comes to information *access*, due to the huge number of open sources at the Internet. Anyone can now access databases which were previously only available through paid subscriptions in libraries, or retrieve digital documents which were much less available in a few printed copies. However, the challenge of *expressing one's knowledge gap in adequate search terms* is still there. Unfortunately, new technology has not made users more skilful searchers when it comes to expressing information needs – "it may be that the general lack of increase in expertise in information retrieval may be due – ironically – to the perceived ease with which digital systems (as exemplified by the Web) can be searched" (Gunter, Rowlands, & Nicholas 2009:131).

If learning – including the information search process – is to build on students' current knowledge, how can the students bring their knowledge into the open? Current knowledge can be activated by all kinds of language use (Evans 2006; Jackendoff 2002). I want to explore how students can do this by elaborating their work tasks on their own in several terminological steps. An information-based work task is understood as the task of writing a student paper, containing sub-tasks like choice of topic, information searching, writing, revision, etc. So the search task is embedded in the information-based work task. In the search task, the students try to remedy their knowledge gap. I want to explore the students' formulation of their work tasks at various developmental stages, arriving at tentative search term formulations, before an assumed search situation. Thus, I want to study the cognitive processes of information searchers in the prefocus stage without involving actual system usage.

What characterizes students' information behaviour when they have to fend for themselves, recalling their own current knowledge? This aspect of information need formulation has motivated my first (out of three) research questions. The research questions will be presented in section 1.5, after the introduction of the concept of *user revealment* (cf. section 1.2), previous research (1.3), and justification of the study (1.4). To explore students' information behaviour, I have made a research design involving a laboratory setting with *simulated work tasks* (cf. section 3.4.1.1), as this cognitive process is usually tacit in the user (and intertwined with search system interaction), and not naturally expressed in a way which can be logged. However, the aim was to make the setup as real-life as possible, in providing the students with assignments made for their own course study, and integrating the informant session in their course schedule. The isolation of the prefocus stage as a process not involving system use has thus been a prerequisite in the research design, for me to be able to study the students' abilities in information need elaboration based on their own current knowledge. In a real-life setting, of course, online searching permeates all the work task stages, including the prefocus stage.

I also ask myself how the students can benefit from their teachers' terminological competence in the *topical area*[2] in question (cf. research question 2 in section 1.5). I want to gain an *insight* into, and explore *whether* – and possibly *how* – an associative semantic network can help the students in their information need formulation. Thus, I will explore how

[2] I use the word *topical area* to refer to an area of topical knowledge. In the information science field, this is also called *domain*, *topical domain*, *subject domain*, or *knowledge domain*. I use the words *topical experts* and *topical novices* to refer to people with respect to their amount of experience and knowledge within a given topical area.

students utilize teachers' word associations and relationship descriptions (i.e. descriptive texts explaining the relationship between each pair of words) entered into an associative network. I will use *associative data* to refer to the sum of word associations and relationship descriptions. In the empirical study I have collected associative data from teachers and established a database called *PedNett*, explicitly for the purpose of the collection of empirical data from students. The name PedNett is inspired by the fact that I have selected *pedagogic terminology* as the topical area in which I performed my empirical study. The topical area of pedagogy deals with the profession of teaching, and is included in the larger area of educational science.

In the informant sessions, the students were instructed to structure a brainstorm, clarify their information needs, and formulate tentative search terms – first on their own, and then using PedNett. The potential benefit of this kind of searching support has been explored on the basis of the informants' actual use in the process of formulating their information needs, as well as their expressions of conceived usefulness. I have also asked myself how differences in the students' use and evaluation of the PedNett database relate to differences in their *learning style* (cf. research question 3 in section 1.5). Knowledge about the students' information need formulation behaviour will be used in a discussion about implications for information system design, as well as information literacy training.

Even though I isolate a presearch stage in my research design, it does not follow that I assume an isolated presearch stage in the students' information search process. The rationale for the presearch stage in my research design is for me to be able to collect data on the students' abilities in information need formulation without the influence of search hits. The implications for use, however, would be to find design criteria for tools which would be presented to the users the moment they initiate an online interaction on any of their mobile devices. If the empirical study indicates that students benefit from elaborating their information needs at word level before they are confronted with massive search results, the implication would be that this kind of 'terminological tool' should be available whenever they initiate a search.

1.2 User revealment revisited: Setting the scene

The empirical explorations of my project start when the student informants are assigned a new work task and they are faced with an information need on that occasion. It ends with the students' tentative search term formulations, prior to an assumed search situation. This means that the present project focuses on the prefocus stage, contrary to many information searching studies starting at search onset.

1.2.1 Introducing the concepts

In this thesis I revisit the concept of *user revealment* which was first introduced by Nordlie (2000)[3]. A presentation of the distinctions between his and my interpretations of the concept is necessary, as we approach the revealment process from different viewpoints. I use the concept *revealment* to refer to "an act of revealing", i.e. to "make something known" or to disclose something, as in "to reveal a secret"[4]. In the compound *user revealment*, it is applied to refer to the cognitive process in which an information need becomes more and more clear to someone, i.e. the user's clarification of her/his information need throughout an information-based work task. The revealment process is initiated when a knowledge gap emerges (in this setting when the students are assigned a work task), and develops throughout the different stages of the work task until it is completed, as described in Kuhlthau's (2004) model of the information search process. *User* means a user of an information system – not just during actual searching, but throughout the information search process, including pre- and post-search activities (Bates 1977; Belkin, Oddy & Brooks 1982a, 1982b; Nordlie 2000). In this thesis the users under investigation are students working on an assignment and facing terminological challenges prior to search onset – keeping in mind that the revealment process takes place in the users throughout the search process.

There is a distinction between Nordlie's and my use of the concept when it comes to *who* initiates the revealment. In the present thesis, I conceive of revealment as the cognitive process in a student elaborating an information need. So the *user* is revealed – caused by cognitive elaboration on the work task – when s/he gradually gets a clearer picture of her/his information need. Nordlie (2000) defines the concept of *revealment* in a different manner. He explores how reference interactions between library users and librarians can inform online searching system design or aid the instructors of online searchers. The potential application area of his project lies in the computer end of the human-computer interaction, as to how we can improve human-computer interaction inspired by our knowledge of successful user-intermediary interaction. He asks himself how the computer can *reveal the users*, i.e. uncover the information needs of the users. Nordlie starts by considering the distance between library

[3] Nordlie (personal communication) ascribes the idea of selecting the term *user revealment* – to refer to his PhD topic – to Paul Kantor, professor of information science at Rutgers University.
[4] Merruan-Webster at http://www.merriam-webster.com/.

users' information needs as first expressed to an intermediary, as opposed to the clarified information needs as revealed during the reference interview. In this situation the librarian reveals the user, and the aim is to build semantic help (e.g., a tool presenting alternative terms) into the searching system so that the system can perform a similar revealment of the users. In a situation where users perform searches on their own without intermediary interaction, they often might face system responses like 'no documents found' or '2 650 000 documents found'. A system which can reveal the users should ideally be able to uncover the users' actual information needs and remedy such frustrating situations.

So who or what is revealed, and by whom? In the present thesis using the concept of *user revealment*, the *students* are revealed as a result of cognitive processes evolving during *their own efforts* to formulate their information needs – throughout the work task process. They gradually become more aware of their actual information needs. We might say that the students' minds are 'enlightened' during the process of getting the grip of their own information needs. So in this thesis, the concept of revealment refers to a *cognitive activity/process* taking place in the users during information need elaboration, and the *resulting state* of them being cognitively more aware of their information needs. My interpretation of the revealment concept can thus be labelled *cognitive user revealment.*

When Nordlie (2000) uses the concept of *user revealment,* the *information needs of the users are revealed* – in the model situation by an *intermediary*, and in a potential applied context by a *searching system*. In conformity with my interpretation of *revealment*, Nordlie's *user revealment* also has a *process* plus *result* meaning, but whereas my interpretation of the concept refers to a cognitive process in the searcher, Nordlie's interpretation refers to a process and resulting state external to the user of the searching system. His *user revealment* refers to the searching system's (or intermediary's) efforts in uncovering the user's actual information need, and the resulting state of a well-defined information need for the system to use in the retrieval process. Nordlie's application of the revealment concept can thus be labelled *system-driven user revealment.*

Of course both cognitive user revealment and system-driven user revealment these processes and results are necessary in a successful information search process – both revealment external to the user, and the searcher's internal process. The retrieval system (or the intermediary) needs to find out what the actual information need of the user *is* (and, as Nordlie states, the user's first statement about her/his information need is often not accurate enough) – and the user herself/himself needs to clarify her/his information need. Without ignoring the importance of Nordlie's user revealment, I want to focus on the searcher's internal process, i.e. the cognitive process of user revealment.

1.2.2 Information need elaboration as a linguistic process

I will use cognitive linguistic theory as a basis for the data analysis, a theory which understands the linguistic capacity as an integrated part of our general cognitive abilities (Langacker 1987, 1991, 2007, 2008; Evans & Green 2006; Taylor 2002). The value of employing this approach in my study, is that it provides an understanding of how knowledge is represented in people's minds, which is different from how these matters are traditionally handled in knowledge organization (cf. section 1.3.5). The main issue is that relationships between words are unique – just as unique as the words themselves – and they are associative, not hierarchical. Relationships carry meaning (Langacker 2008), so a word is not 'defined' on its own, but in relation to other words. Consider, e.g., (inspired by Langacker 2008:67) how *Monday, Tuesday, Wednesday*, etc., is defined in relation to each other and relative to the conception of a *week.* Similarly, the understanding of the words *hub, spoke,* and *rim* are interpreted in relation to each other and to the word designating the whole, a *wheel*. Every word is understood with respect to 'chunks' of conceptual knowledge making up its context. These chunks will be referred to as *frames* (Fillmore 1975, 1977a, 1977b, 1985), which will be thoroughly presented in section 2.3.1. For now, we may say that the meanings of words are made up by their relationship to conceptual knowledge, also referred to as *frame knowledge*. The amount of conceptual knowledge making up the context of a word, will be called a *frame*.

I conceive of the information need elaboration process as a linguistic activity, and accordingly I investigate this process as a communication situation from a cognitive perspective. Cognitive linguistic theory has a conceptualistic starting point – that is to say, there is a focus on language as a *mental phenomenon*. Conceptual knowledge is used to refer to the coherent body of lexical and encyclopedic knowledge, i.e. the sum of mentally stored knowledge (cf. section 2.3). The meanings of words are interpreted in relation to conceptual knowledge. This is called the encyclopedic nature of linguistic meaning.

In approaching the human capacity for language, an important aspect is the nature of the conceptual structures in the mind, including the acquisition and activation of these structures, and how these structures are mediated through language. I want to gain an insight into the processes of knowledge formation in the prefocus stage, to be able to come up with suggestions for system design which might support students in their information need formulation. Acquisition, organization and activation of conceptual structures are all intertwined, so assumptions and explorations concerning linguistic processes have to be based on assumptions concerning linguistic structures.

According to the bottom-up approach in cognitive linguistic theory, linguistic structures emerge through language use, and “the social and cultural context in which language is used would have an impact on structures that are created” (Bybee 2010:204). This is traditionally in contrast to the top-down approach in the generative linguistic paradigm, claiming that linguistic structure (called competence) directs language processing (called performance). So generative linguistics has had a primary focus on competence, whereas cognitive linguistics has had the ‘heavier foot’ on the performance end. Nowadays we find linguists who emphasize that the influence must go in both directions. Jackendoff (2002), e.g., dissociate himself from both these positions, stating that there is no either-or concerning the importance played by competence and performance. He brings forth his *Parallel Architecture* which lends itself to a direct relationship between theories of linguistic structure and theories of language processing. His model makes use of parallel processing in which there is a two-way influence between linguistic structure and language processing.

My research topic concerns several aspects of the nature of conceptual structures; i.e. acquisition of terminology and conceptual knowledge in a topical area, and the activation of knowledge structures in the information need elaboration process. In considering the information need formulation process as a cognitive linguistic process, I have to be aware of the kind of language which is used in this context. Students formulating information needs are in a process of acquiring terminological competence and conceptual knowledge in a topical area – which, in the case of the present project, is the area of pedagogy. So I am concerned with area-specific terminological competence, not acquisition of new daily-life vocabulary, and activation of this area-specific terminology in a situation of information need elaboration. Cognitive linguistic theory does not make any predictions on the kind of language (i.e. area-specific terminology), or the type of language use (i.e. information need formulation) which we find in the present project. Neither does it restrict its application to natural language use in ordinary conversation. I find it well justified to explore how a cognitive linguistic approach can be used to describe the complexities of the specific language use situation of information need formulation.

My project deals with activation of terminology in a special context of language use, i.e. a process of prefocus information need formulation which is imposed upon the informants in an experimental setting. The language production is also special in that it primarily involves processing at word level, with words expressing topical facets in several terminological steps. These differences should be kept in mind in the data analysis. However, there are inspirational parallels to be drawn, and I have a basic assumption that the psychological and linguistic processes on the scene in natural language use are also relevant in the study of the activation of conceptual knowledge related to a topical area in relation to information need formulation.

1.2.3 The semantic challenge in information searching

The concept *semantic* is used both in information science and in cognitive linguistics, but with a more specific meaning in the latter case. Basically, semantics is the "study of meaning", and the adjective *semantic* relates to "the meanings of words and phrases"[5]. In information science, *semantic* is used to refer to 'meaning-related'/'conceptual'/'content-related' (as opposed to form or structure), as in semantic structures, semantic tools, semantic input, semantic content, semantic relationships, semantic help, semantic network, and semantic feedback.

The concept *semantic* has a more specific meaning in cognitive linguistics, to refer to the theoretical claims about how linguistic meaning is acquired, represented and organized. Cognitive semantics is a major concern within the cognitive linguistic enterprise, and it refers to how linguistic meaning is understood: Words are interpreted in relation to conceptual knowledge. Knowledge of language is acquired in a usage context, and the ability to use language draws upon general cognitive resources and not a special language module. The conceptualistic semantic approach in cognitive linguistic (the understanding that meaning potential is identified with conceptualization) is opposed to an alternative approach in which words are defined by 'necessary and sufficient conditions' (cf. section 2.3.2).

I will use the concept *semantic* both with the general 'meaning' interpretation as in information science (especially in chapters 1-2), and in the cognitive linguistic understanding as 'conceptualistic approach to meaning' (cf. sections 1.3.2 and 2.3-2.4). In chapters 3-6 I will present and discuss 'the semantic network PedNett' – referring to a network of pedagogic terminology in which the units (words) are related by meaningful relationships (individual associative relationships).

The *semantic challenge* in information searching refers to the conceptual challenge in expressing an information need, including the antagonism between having a knowledge gap and the need to express 'what you do not know'. Svenonius (2000) claims that efforts to

[5] Merruan-Webster at http://www.merriam-webster.com/.

automate the organization as well as the retrieval of information comes up against a *semantic barrier*: “At this barrier questions of meaning and significance intrude, which means that efforts to automate the organization of information must then fall back on lexical information intellectually compiled and structured” (Svenonius 2000:198). She introduces the concept in association with human-computer interaction. I conceive of the semantic barrier in users’ information searching as the cognitive challenge of expressing a knowledge gap – e.g., the difficulty of finding adequate search terms to represent an information need, and the challenge of coming up with alternative search terms if the first ones used do not provide a satisfactory result. Svenonius underscores a need for human-computer interaction to supply semantic feedback, e.g., in the form of terminological tools providing related terms, synonyms, etc., and the observation that purely automatic approaches to retrieval (like, e.g., automatic query expansion) will face a semantic barrier.

My focus is on the students’ comprehension of their information needs which are developed throughout their work tasks, and how these needs are expressed linguistically in the prefocus stage. Taylor (1968:182, italics original) identifies four levels of expression of an information need:

> Q1 – the actual, but unexpressed need for information (the *visceral* need)
> Q2 – the conscious, within-brain description of the need (the *conscious* need)
> Q3 – the formal statement of the need (the *formalized* need);
> Q4 – the question as presented to the information system (the *compromised* need).

I consider Q3 to be the *initial information need* formulation. *Query* formulation (Q4) refers to the question as presented to the information system. This is also referred to in the literature as a *search* formulation or *request* formulation. A *query* is more specifically the full expression of the compromised need, whereas *search terms* refer to the component parts of a query. In the empirical study of the present study, the informants arrived in the last terminological step at what I call *tentative queries* containing *tentative search terms,* as no actual searching was involved. This can be considered as a pre-stage to Q4.

It is important to note that an information need evolves throughout a work task process. Cole (2012) elaborates a theory of information needs linking information searching and knowledge formation. He states that information needs are made up of levels, and that “the underlying information need in fact does not instantiate fully until the user achieves focus” (Cole 2012:194). He states that information needs, information use and information demands occur along a *continuum* or *scale,* and that knowledge formation is an incremental process along this scale. “[L]ow knowledge about the needed information is correlated with the need as being unarticulated in the user's own mind, while high knowledge about the needed information is correlated with the user making a demand on the information system for the needed and known-about-beforehand information" (Cole 2012:16-17).

Relevant in this respect is also Belkin's ASK hypothesis (i.e. Anomalous State of Knowledge), claiming that:

> [...] an information need arises from a recognized anomaly in the user's state of knowledge concerning some topic or situation and that, in general, the user is unable to specify precisely what is needed to resolve that anomaly. Thus, for the purpose of IR, it is more suitable to attempt to describe that ASK, than to ask the user to specify her/his need as a request to the system. (Belkin, Oddy & Brooks 1982a:62)

In their 1982 study, Belkin, Oddy & Brooks let their informants orally present their ASKs as problem statements during an interview session prior to presenting a more formal request (i.e. query) to the system which they intended to use (Belkin, Oddy & Brooks 1982b). In my study I try to capture the informants' ASK in a laboratory setting, using simulated work tasks (Borlund 2000), in which the informants work at word level, in writing, in several terminological steps to clarify and formulate their information needs and prepare for the information search process. This information need elaboration process I call user revealment during the prefocus stage.

Though my project focuses on the stages prior to an actual search, the implications of the study will be related to Bates' (1986) proposal of an *end-user thesaurus* used in the search process, to improve searchers' success during the entry and orientation stages in subject catalogue access. (End-user thesaurus is also called *searching thesaurus* in information science literature and in this thesis). An end-user thesaurus should according to Bates contain a large lead-in vocabulary of related terms (i.e. associative relationships) in addition to the thesaurus terms organized according to the classical hierarchical thesaurus relationships (broader terms, narrower terms, synonyms, and related terms). The lead-in vocabulary should contain clusters of alternative terms associated with each preferred term, provided by the system as a response to the searchers' own suggested search terms. An end-user thesaurus exploits the basic principle in psychological research that recognition of words is much easier than recall. (*Recall* is here used in the psychological sense of the word, as *recall from memory* – I do not here refer to the recall versus precision distinction in information retrieval theory). The searcher needs only "hit the side of the barn" Bates (1986:358) to get into the vocabulary of the retrieval system. An end-user thesaurus should contain a vast entry vocabulary, geared to end-user propensities. Each term in the entry vocabulary should in turn be linked to preferred terms in a standard thesaurus based on classical thesaurus relationships. The topic of recognition versus recall will be discussed further in section 2.5.2 concerning psychological factors involved in the information need formulation process.

1.2.4 Information searching then and now: The Google generation

In the data analysis (chapter 4) I explore whether my informants exhibit the characteristics of young information searchers as described in Rowlands et al. (2008). My informants, most of them in their twenties, represent the Google generation which typically exhibit an information behaviour with digital choice in a surfeit of information. The article discusses whether this situation hampers creativity and independent thinking. The Google generation’s information searching is done in an increasingly disintermediated environment. “Young people have a poor understanding of their information needs and thus find it difficult to develop effective search strategies” (Rowlands et al. 2008:295). They prefer to express themselves in natural language (i.e. full sentences) rather than search terms (single words), and when searching the Internet, little time is spent in evaluating information.

I collected the empirical data in 2009, and since then the technological development has changed the information behaviour of young people even further in the direction of ‘always online on a mobile device’. I will relate my discussion in chapter 5 to recent research on these trends (Beheshti & Large 2013; Devine & Egger-Sider 2014; Gunter, Rowlands & Nicholas 2009; Mills, Knezek & Khaddage 2014; Nicholas et al. 2011; Nicholas & Clark 2013; Rowlands et al. 2008; Rowlands & Nicholas 2008).

1.3 Previous research and theoretical preliminaries

I will use an interdisciplinary perspective, in which I draw upon theories from the fields of *information searching*, *cognitive linguistics*, and *cognitive psychology*. I have not found any previous studies combining cognitive linguistic and psychological theory with information searching. I find it relevant to use some basic tenets from these paradigms as a back cloth rather than deducing specific propositions from the theories to be tested in the information searching field. In chapter 2 on the theoretical framework, I will draw on these perspectives in approaching the topic of formulation of information needs and terminological competence. I will provide a cognitive linguistic perspective on the semantic challenge in information searching, and present some psychological factors involved in the information need formulation process. In sections 1.3.1-1.3.3 below, I will give just a brief encounter of these three theoretical perspectives, which will be thoroughly presented in the next chapter. This will be followed by an integration of theoretical perspectives on the concepts *cognitive* and *context* (1.3.4), as well as a comparison of semantic relationships in thesauri and in the mental lexicon, drawing on perspectives used in cognitive linguistics and information searching (1.3.5).

1.3.1 Information searching theory

I consider my research topic to be in the area of *cognitive information searching*, since I want to explore cognitive processes of information need elaboration in the user. Cognitive information searching is opposed to, e.g., collaborative information searching dealing with the social perspective. To my knowledge, there is no separate research field concerning the prefocus stage of information searching. Cole (2012), however, devotes a large part of his *information need theory* to the prefocus stage (cf. section 2.4.3).

Svenonius (2000:ix) states in her preface that "[i]nstant electronic access to digital information is the single most distinguishing attribute of the information age". With today's access to the Internet and an abundance of electronic resources, it is very easy for information searchers to just 'throw' a few terms into a searching system and see what comes out of it. Rather than spending time on search preparations, they spend time on relevance judgements of hits. This has naturally led to a large body of research on information retrieval interaction (in line with Ingwersen 1992, 1999). A lot of research in the 1990s were concerned with search term selection and preparation of searches, e.g., comparing professional searchers' use of a controlled vocabulary versus free-text search (Fidel 1991a, 199b, 1991c), whereas the first decade of this century has seen much research on relevance judgements and evaluation of retrieval systems (e.g., Borlund 2000, 2003). Some researchers concentrate on the information need and the search process seen in the context of a work task (e.g., Kuhlthau 1993, 2004; Vakkari 2000; Vakkari, Pennanen, Serola 2003). Current research devotes attention to issues like the information behaviour of the Google generation (Beheshti & Large 2013), and information (il)literacy (Devine & Egger-Sider 2014).

I use *information searching* in accord with Wilson (1999:263), as "the interactions between information user (with or without intermediary) and computer-based information systems". Information searching is also concerned with quality criteria and search strategies. Information searching is understood as a narrower concept than *information seeking*, including any methods people employ to gain access to information resources (such as browsing, observing, reading, and consulting friends), not just computer-based information searching. Wilson (1999) presents a nested model of the information behaviour research area, as three circles embedded in each other. The outer circle is called *information behaviour*. Inside we find a new circle called *information seeking behaviour*. The inner-most circle is called *information search behaviour*. This research area is particularly concerned with the interactions between humans and computer-based information systems. The *prefocus stage* of the information search process can be understood as a part of this innermost circle – which is coloured by uncertainty due to the vagueness of the users' information need (Kuhlthau 2004). If the prefocus stage involves searching, it is of an exploratory nature. Comparing the concepts information *searching* versus information *retrieval*, the first one is more concerned with the human end, whereas the latter is more concerned with the computer end of the human-computer interaction. I thus see information searching as a concept between information seeking and information retrieval, and the prefocus stage in the context of this thesis as a subpart of information searching.

The focus in this thesis will be on an exploration of whether – and possibly how – an associative semantic network can help students in their information need formulation process. If students can benefit from experts' terminological understanding of a topical area – expressed in an associative network – a PedNett-kind of tool can be used in search preparations for the activation of current conceptual knowledge. But why do so many students find it difficult to search for adequate literature when they write assignments on their study? From studies of search logs (Nordlie 2000), we know that search term selection is a recurring problem. Information searchers face problems in formulating and reformulating their queries in a manner which can provide them with relevant and useful hits. Most studies concerned with the semantic aspects of information searching, start at the initial stage of the human-computer interaction, studying searchers' well-known problem in capturing the vocabulary of a searching system and formulating and reformulating queries (cf., e.g., Bates 1977; Fidel 1991a, 1991b, 1991c; Saracevic et al. 1988; Saracevic & Kantor 1988a, 1988b). The 'think-aloud' method has been used to reveal the cognitive perspective of the search process, as to how information searchers conceive of their search term selection and query reformulation (cf., e.g., Pharo 2002; Pharo & Järvelin 2004).

In the transitional phase between mediated information retrieval (with the library user helped by a librarian) and the new area with the information searchers taking charge themselves, some authors have had a focus on the consequences of *disintermediation* (see, e.g., Downie 1998; Fourie 1999; Nicholas 2012). Many researchers have used the user-librarian interaction as a model for what kind of help should be built into searching systems to make them user friendly (Buckland 2001; Ingwersen 1986, 1999; Kuhlthau, Spink, & Cool 1992; Spink, Goodrum, & Robins 1998; Spink & Sollenberger 2004). When the intermediary is no longer there in a search situation, the information searchers need to be information literate. They also need access to systems supplied with built-in semantic help, if the searchers are to be able to fend for themselves in the search situation.

Iivonen & Sonnenwald (1998) are concerned with professional searchers' search term selection in what they label the *pre-online stage* of the search process – though they consider search term selection to be a critical issue during the entire search process. They arrive at a model of search term selection in the pre-online stage, characterizing the selection of search terms as the *navigation of different discourses*: "[T]he selection of search terms may be viewed as a process where searchers step into various discourses and encounter, or discover, different ways of talking about the same topic. Search terms may be viewed as a meeting place, or crossroads, of various discourses, i.e. those places where concepts intersect in some way" Iivonen & Sonnenwald (1998:313). Searchers have to dynamically navigate between multiple discourses during the search term selection process, both in the prefocus stage and during online searching. So Iivonen & Sonnenwald investigate how a given topic is terminologically represented in a variety of discourses. They identify six emerging discourses as sources of search terms in their study. These are: controlled vocabularies, documents from the topical area, the practice of indexing, library users' search formulations (i.e. query formulations), databases, and the searchers' own search experience. Iivonen & Sonnenwald's *discourse model* serves as an alternative to the traditional *translation model* of the search term selection process, of which we have already seen an example in section 1.2.3 with Taylor's (1968) visceral, conscious, formalized, and compromised need.

In business and marketing theory, they apply the concept of *co-creation* (Prahalad & Ramaswamy 2004), concerning how today's customers are *actors*, not *consumers* in the relationship between the customers, the companies, and their products. This has a parallel in the way we have to see the searchers today – not as passive *information consumers* who 'glug down' whatever the intermediaries serve them, but *information actors* who are in charge of both the establishment and revealment of their own information needs. The information specialists' job will be to help information searchers to help themselves. Neither the intermediaries nor the system will be able to reveal the searchers' information needs if they do not take an active part in the revealment process themselves. The users need to be information literate, not only when it comes to actual searching skills, but also concerning the work task process and the evolvement of information needs.

1.3.2 Cognitive linguistic theory

In the cognitive linguistic approach, there is no sharp distinction between word meaning and encyclopedic knowledge (cf. section 2.3). This theory provides a framework for the understanding of how conceptual knowledge is represented in the mind (Langacker 1987, 1991, 2007, 2008; Evans & Green 2006; Taylor 2002). Words are defined relative to conceptual knowledge, not as separate linguistic units. All conceptual knowledge is associatively related. Neither is there a sharp distinction between language use and thinking – it is all considered as cognitive processes in the mind. So when a student elaborates on her/his information need and tries to formulate it, this is an integrated process. In using the expression 'elaboration and formulation of information needs', the *formulation* is the linguistic expression which is an integral part of a *cognitive elaboration* process.

One might object that there is a major difference between natural language acquisition and use, and the situations of students learning new terminology and formulating information needs – the first occurring naturally and unplanned, and the latter being 'less natural' in that it does not evolve as an ordinary conversation, but as a conscious and arranged process. From a cognitive linguistic point of view, I would say that both situations are instances of language use and as such subject to linguistic analysis. Natural language use takes many different forms, as does 'arranged' situations in which language use occurs. For instance, the situation of an adult and a child reading a picture book and talking about what they see, has many aspects in common with the situation of teachers and students in a classroom situation. Both situations involve exposure to, and acquisition of new terminology. Students' activation of their terminology during information need formulation is essentially similar to children experimenting with newly learnt words. These are all usage events – instantiations of language use – activating conceptual knowledge structures.

In acquiring new knowledge, language serves as an instrument for organizing, processing, and conveying conceptualizations. Mentally stored knowledge is seen as a meaning potential which is activated and assigned meaning in the form of contextualized usage events. I will use *meaning potential* in the description of mentally stored knowledge to emphasize that meaning is not stored as such, but resides mentally as a *potential* for meaning construction. Meaning is not created until words occur in usage events. As Evans (2006:527) eloquently points out, "meaning is not a property of words, but rather of the utterance: that is, a function of situated use". Langacker (2007:428) states that "a linguistic system is merely a vast inventory of conventional units", and that we employ "general and contextual knowledge" in speaking and understanding of usage events. Meaning is constructed during language use, and I will study language use in the prefocus stage of information need formulation, a process which I refer to as user revealment.

I have as a basic assumption that by activating linguistic semantic structures in the mind, people can access more and better words to express their speaking needs (written/oral), including information need formulation. In this I state something about linguistic processing. Cognitive linguistic theory primarily deals with the *representation* of conceptual knowledge, not the processing perspective. However, in line with Jackendoff (2002), I find it viable to base my assumptions about linguistic processing on what the theory states about linguistic representation. (Jackendoff is associated with the generative linguistic paradigm. However, he states that any presumption about linguistic processing should be based on linguistic theory of representation).

Cognitive linguistic theory includes the concept of *continuum* which is applicable in the area of information searching. Many human phenomena appear along a continuum. Often there is no *either-or*, but rather *degrees* of a phenomenon. A word is not either stored or not stored in the mental lexicon – it is *entrenched* to a certain degree. This line of thought is very useful in the interpretation of my empirical data. For instance, in asking whether learning style influences the way students make use of the PedNett database, it turns out that number of terms relates to the *degree* of deep learning style. This is useful in exploring and describing the complexity and individual variation in human behaviour.

In the layout of the cognitive linguistic theory on the representation of conceptually stored knowledge, I will use the concepts of *frames* according to Fillmore (1975, 1977a, 1977b, 1985), cf. section 2.3.1. Frames are understood as the amount of conceptual knowledge making up the context of a word. A frame cuts out a chunk of conceptual knowledge which is relevant for the interpretation of language use in a given situation. I will arrive at the concept of *frames* as the basic theoretical construct in the application of cognitive linguistic theory in the interpretation of the empirical data.

In addition to Fillmore and Langacker, I will base the layout on cognitive linguistics in chapter 2 on Croft & Cruse (2004), Evans (2006), Evans & Green (2006), Geeraerts & Cuyckens (2007), and Lakoff (1987). I wish to integrate theory on the cognitive mental lexicon with theory on cognitive aspects of information searching. An important inspiration in the integration of perspectives from linguistic theory and knowledge organization, will be fetched from Bean & Green (2001), Green (2002, 2008), Green & Bean (1995a, 1995b) and

Svenonius (2000). These are concerned with relationships in knowledge organization, but also refer to linguistic literature – however not cognitive linguistics. The understanding of relationships is important in the integration of cognitive linguistics with knowledge organization. Cognitive linguistic theory makes claims about the organization of the mental lexicon – which is basically associative. This is opposed to knowledge organization which is aimed at organizing document-based knowledge – primarily based on hierarchical structures.

1.3.3 Cognitive psychological theory

Not only linguistic, but also psychological processes are triggered when students elaborate their information needs in the prefocus stage. I will look into three psychological mechanisms which come into play in information need processing.

First, I will consider the distinction between *recognition* versus *recall* in the retrieval of memory. Anderson (2000) describes how recognition is easier than recall, because recognition provides more retrieval cues. That is, it is easier for a user to *recognize* a term as relevant, than to *recall* the same term from memory without any cueing. This vouches for an interaction with a *recognition tool* in the prefocus stage of information searching. The second mechanism I will describe, is the *spreading activation* theory, which is commonly used in connectionist models in cognitive psychology (Eysenck 2001). Psychological processes can be described by interconnected networks of units, and the spreading activation theory explains how semantically related units are activated through these networks. The third mechanism which will be presented, deals with causes of *recall problems* (Reisberg 2001), particularly the *winner-takes-all system*. This concerns how – once a word has been retrieved from memory – related nodes are weakened. I will also present the basic causes of *forgetting* according to cognitive psychological research.

In the layout of psychological mechanisms, I will relate the cognitive psychology to the perspectives from cognitive linguistics and information searching theory, with the overall aim of getting a better understanding of students' formulation behaviour in the prefocus stage. The ultimate goal is to suggest how this knowledge can be used in the development of built-in searching tools which can support information searchers in their query formulations.

1.3.4 Cognitive and context: Integration of theoretical perspectives

I am concerned with the concepts of *cognitive* and *context* in exploring the elaboration and formulation of information needs in the prefocus stage of students' work tasks. All the three theoretical approaches which I apply – information searching, cognitive linguistics, and cognitive psychology – share a focus on these two concepts. *Cognitive* and *context* are both rich with potential meanings. In this project, *cognitive* refers to the mental representation and activation of knowledge in the user during the information need elaboration process. *Context* is in this project used to refer to the linguistic context of words, in two respects: The first interpretation concerns the *mental* context, i.e. the conceptual knowledge associated with a given word, defined as the sum of linguistic and encyclopedic knowledge. The mental context of a word refers not only to the meaning potential of the word itself, but to all the contexts in which the word can take part. The second use of the concept of context in this project refers to the context of *use*, e.g., how a word is used in the context of a work task. The context of a word refers to the usage event in which it takes part. So I use a *cognitive* and *contextual* approach to my research topic.

Let us now look at how the concepts *cognitive* and *context* are used in information seeking and retrieval literature, specifically in the field known as *cognitive* information retrieval, also called *interactive* information retrieval (Ingwersen 1992, 1999). I prefer to use the concept cognitive information *searching*, as my topic deals with the human end of the human-computer interaction, and I associate retrieval with the machine contribution in the search process. The cognitive view in information searching is treated in Ingwersen & Järvelin (2005), reviewing research into cognitive information searching and proposes a framework for future research with a focus on *context*.

As we noted with the concept *cognitive*, the concept of *context* is also much used in information seeking and retrieval research, often referred to as IRiX (Information Retrieval in Context). Ingwersen & Järvelin (2005) list a lot of elements of context, which are potentially significant to information retrieval: work or daily-life tasks or interest features, searcher features, interaction features, system features, document features, environmental/physical features, and temporal features. We see that context in information retrieval is understood as all kinds of external *and* internal features affecting information retrieval. I am concerned with internal features, i.e. the understanding of context as individual cognitive processes and conceptual knowledge.

Both Ingwersen & Järvelin (2005) and Spink & Cole (2005) are concerned with the cognitive and interactive human-computer perspective on the information search process, as opposed to retrieval system performance. Models of cognitive information searching try to describe people's perceptions of the information that they need and search for, and the relationship between how this is represented in the information searchers' minds and in the information systems, respectively. The aim is to design the information systems in a way which is adapted to how information searchers act – cognitively and practically – when they are searching. Accordingly, there is a focus on information behaviour studies in cognitive information searching research.

In the present empirical project concerning the prefocus stage, the main issue is how students' information needs are expressed linguistically in several terminological steps *prior* to actual online searching (though, in a real-life setting users indeed perform searches also in the prefocus stage). I am concerned with the *cognitive context* of information need formulation, i.e. the individual cognitive processes and the context of conceptual knowledge in which prefocus information need formulation takes place. This is based on an understanding of linguistic meaning as a function of language use.

1.3.5 Semantic relationships in thesauri and in the mental lexicon: An integration of perspectives used in cognitive linguistics and information searching

The semantic network PedNett which is developed for the purpose of this project, is based on word associations and relationship descriptions. Each relationship between a word pair is to be considered as a unique associative relationship. Several research projects in information retrieval have applied semantic relationships (specifically thesaurus relationships), e.g., in *interactive* (Vakkari, Pennanen & Serola 2003; Sihvonen & Vakkari 2004a, 2004b), and *automatic* (Greenberg 1998; Kekäläinen 1999) query expansion. Vakkari, Pennanen & Serola (2003) organize their informant data about students' changes of search terms and tactics (while writing a research proposal) into thesaurus relationships. When terms are categorized according to thesaurus relationships in these projects, the associative relationship (expressed as related terms (RT)) makes up a large category compared with the hierarchical relationships (narrower terms (NT), broader terms (BT)) and the equivalence relationship (USE/USED FOR).

There is a growing interest in associative relationships in the field of information retrieval. In thesauri, associative relationships are usually treated as one group of related terms, though they can logically be of various kinds (e.g., the relationship between *operation* and *product* like in 'churning ↔ butter', between *action* and *object* like in 'imprisonment ↔ prisoners', or between *topic* and *object of study* like in 'botany ↔ plants'). Aitchinson, Gilchrist & Bawden (2000) provide an option with associative relationships categorized according to *facet indicators*. A facet indicator is a note label explaining the meaning of a term in a heading. E.g., under the entry term *Firefighting*, the facet indicator *Equipment* might precede a group of related terms like *Branching equipment*, *Fire hoses*, and *Ladders*). Example cited from Aitchinson, Gilchrist & Bawden (2000:67).

Lykke Nielsen (2002:178) states that "[t]here is an increased interest in developing the thesaural definitions and in organising the associative relationships in categories". Several inventories of associative relationships types have been made, e.g., ALA (1997). More suggestions are cited in Bean & Green (2001) and Tudhope (2001). No common standard is yet established – probably for reasons stated in Aitchinson, Gilchrist & Bawden (2000:62) that "the lack of finer categorizing is in part due to the fact that often two terms are helpfully related in ways difficult to verbalize".[6]

The rationale for the hierarchical structure of thesaurus relationships is to be found in knowledge organizational principles. The thesaurus structure is not aimed at mirroring a cognitive reality, i.e. to state how words are actually inter-related in the mental lexicon. Thesaurus relationships are rather inspired by a structuralistic view of the mental lexicon (cf. section 2.3.2). According to a cognitive linguistic understanding of the mental lexicon, relationships as well as units carry individual semantic content (Langacker 2008) – cf. 'weekdays understood in relation to the concept of a seven-days week' and other examples provided in section 1.2.2. The mental lexicon contains thousands of units (words) as well as individual associative relationships. When searchers face difficulties in capturing the vocabulary of searching systems – could a part of the problem be that the searchers' mental lexicon is structured differently than thesauri, and that they face a structural as well as a terminological problem?

In this project, I want to explore whether users can benefit from a kind of semantic help which is based on unique associative relationships. In the semantic network PedNett, the relationships are provided as texts expressing the relationship between the two words making up a word pair (i.e. the stimulus and the response word). So instead of merely stating that there is an associative relationship between two words (i.e. an RT-relationship in thesaurus terminology), I would like to make the meaning of the unique association explicit. This is done in an effort to present the student informants with expressions of the relationships between words, based on the cognitive linguistic assumption that all relationships carry individual semantic content. The motivation is a wish to explore how searchers in the prefocus stage might utilize a semantic tool which is inspired by the structuring principles of

[6] Aitchinson, Gilchrist & Bawden (2000) cites Svenonius (1987). Primary source, not consulted by me: Svenonius, E. (1987). Design of controlled vocabularies. In *Encyclopaedia of library and information science, Vol. 45, Supplement 10* (pp. 82-109) New Yort: Marcel Dekker Inc.

the mental lexicon, i.e. associatively – as opposed to more traditional semantic tools based on a hierarchical structure.

1.4 Justification of the study

The contribution of this study is a closer examination of the prefocus stage of the information search process. With the point of departure that all learning should start with the activation of current knowledge, it is important from an information science perspective to explore this process further. Users' potential of expressing their current knowledge in their own vocabulary is of special interest, as well as how students with unfocused information needs can benefit from experts' terminological competence. The semantic network PedNett which was used in the empirical study, is a kind of tool which is asked for in the literature. Vakkari states:

> In people's conceptual frameworks, the meaning of a term is regulated by its connections to other related terms. [...] In presenting the terms to the users, they should be linked to relevant terms on different levels of hierarchy as well as to synonyms. In an ideal case, the central features of the conceptual structure provided by the system should resemble the mental representation of the users. [...] However, in the topic selection and exploration stages when the user's conceptual model is undifferentiated, any kind of conceptual map would help them to find new dimensions and alternative expressions for their information need. (Vakkari 2000:19)

Vakkari further writhes about 'tools like a searching thesaurus'. This is in line with Bates' (1986, 1990) proposal for an end-user thesaurus, and for her concerns with the design for a subject search interface. Bates also sees the potential in associative searching thesauri like Knapp's (2000) *The contemporary thesaurus of search terms and synonyms* (which will be presented in section 2.5.2 on retrieval of memory in information searching). The rationale behind PedNett is inspired by these lines of thoughts, together with the use of word associations in the manner of Lykke Nielsen (2002). Vakkari (2000) concludes that to achieve better search results, the information searchers should be supported by varied query expansion tools. I consider PedNett as a 'terminologically expansion tool' for initial information need formulations in the prefocus stage. In using PedNett, the students are provided with both a recognition tool (i.e. they are able to recognize something as relevant which they did not come up with themselves), and a tuition tool (i.e. they can acquire new knowledge on word meanings and relationships between words). The benefits of a semantic tool like PedNett and a classical thesaurus might be combined in an end-user thesaurus with a large lead-in vocabulary, of the kind proposed by Bates (1986), cf. section 1.2.3.

We saw above that much research has been done on how people search. Fewer studies have been performed on how people think while they are searching (e.g., Pharo 2002). Even less has been done on how people develop their own vocabulary prior to the search situation. One of few examples is Iivonen & Sonnenwald (1998), which were presented in section 1.3.1. They study search term selection performed by professional searchers, on behalf of library users. The potential contribution of my study is to widen our understanding of the cognitive processes and prefocus vocabulary of students as end-users. The project also asks whether students in the prefocus stage can benefit from a semantic feedback based on experts' terminological competence and knowledge of relationships in a given topical area. So I take a step backwards from what I conceive of as the focus in today's main line of research, i.e. the human-computer interaction. Instead, I focus on the students' cognitive elaboration and interaction with their own current knowledge – first on their own, and afterwards with input from the semantic network PedNett.

The consequences of my study relates to both system performance as well as information literacy training. The project will dwell on aspects of how tentative search terms can be produced throughout the work task process and be used in searching. I will explore the prefocus stage with the intention of finding design criteria for tools which are available for users the moment they initiate online interaction. So knowledge about how users reveal their information needs and activate their current vocabulary can be used to make built-in semantic help in searching systems. To sum up, my reasons for studying the cognitive aspects of the prefocus stage of the information search process is that we need more knowledge about this topic to be able to improve information system design and provide adequate information literacy training for students.

1.5 Research questions

My overall research topic is user revealment, understood as students' cognitive elaboration and formulation of information needs in the prefocus stage. I am interested in how students develop their terminological understanding in the course of information need elaboration which again is embedded in their process of gaining knowledge in a topical area which is new to them. I want to gain an insight into, and explore whether – and possibly *how* – an associative semantic network can help the students in their information need formulation. In the previous sections I have asked myself: How do students formulate their information needs in the early stage of their information-based work tasks? How can students benefit from their teachers' terminological competence? How do students' learning styles affect their formulation behaviour? These tentative questions have to be more precise. Thus, I will investigate my topic equipped with the following research questions, approaching – respectively – the aspects of *work task elaboration* (RQ1), *frame knowledge utilization* (RQ2), and *learning style influence* (RQ3):

RQ1: What characterizes students' elaboration of information-based work tasks and formulation of information needs in the prefocus stage?

RQ2: How do students in the prefocus stage utilize teachers' frame knowledge expressed as word associations and relationship descriptions in the semantic network PedNett?

RQ3: How do differences in the students' use and evaluation of PedNett relate to differences in their learning style?

The results from the empirical study will provide me with a better understanding of students' challenges in information need formulation. This knowledge will be used in a discussion of how students can be supported in the prefocus stage of information-based work tasks – with semantic tools in interactive searching, and in information literacy training.

The motivation of the first research question is my wish to explore students' abilities in information need formulation on their own accord. How, or to what extent, do they manage to activate their own vocabulary concerning the topic of their work task? This will be tested in a laboratory setting without Internet access, because I want to be able to study the informants' formulation behaviour unaffected by massive search hits. In a real-life setting, online searching – including the prefocus stage – takes place in all the work task stages. Knowledge about the students' point of departure and formulation behaviour in the prefocus stage of information-based work tasks is an important input for a discussion of information system design.

The second question is motivated by a curiosity as to the potential of semantic tools like PedNett in helping students recognize and acquire search term candidates in the prefocus stage. This will add to a discussion of content and functionality for built-in semantic tools which searchers might benefit from.

There are a lot of factors influencing students' information need formulation behaviour. The third research question addresses one of these, i.e. the issue of learning style. Students' differences in learning style will provide a perspective on the assumed variation in the empirical data. Knowledge on this matter will be relevant for information professionals, e.g., with respect to information literacy training. I will keep in mind that there are probably several other factors on the scene, too – e.g., personality, IQ and grades in the topical area. These factors are not included in the present study.

I have introduced some basic assumptions earlier in this chapter. These will be summarized below: The psychological and linguistic processes on the scene in natural language use, are also relevant in the study of the activation of conceptual knowledge related to a topical area in relation to information need formulation (cf. section 1.2.2). The motivation for the first and second research question is based on an assumption that by activating linguistic semantic structures in the mind, people can access more and better words to express their speaking needs (written/oral), including information need formulation (cf. section 1.3.2). The activation of current knowledge in the prefocus stage through PedNett use is also founded on a general principle in pedagogy, i.e. that the point of departure for all learning should be the students' current knowledge (Imsen 2005).

1.6 Research design: Preliminary presentation of the empirical study

In this section I will give a brief introduction to the methodology used to investigate the research questions. The theory of method plus research design for the data collection will be presented in chapter 3, whereas the analysis of the empirical data will be provided as chapter 4. I have chosen to present the *theories of method* which I will apply in the data collection, as a part of the empirical study in chapter 3. (This is as opposed to the *theories of analysis* which I will present as a theoretical framework in chapter 2. The theoretical framework motivates the study and is used in the analysis and discussion in chapters 4-5). In the research design I have applied a bottom-up and context-dependent approach in a predominantly qualitative study.

The concept of *frames* has been applied as the governing idea in the motivation of the research design (chapter 3), and in the interpretation of the empirical data (chapter 4). Frames are made up by conceptual knowledge which is essential for the interpretation of words in a given context, cf. thorough presentation in section 2.3.1, and Fillmore (1975, 1977a, 1977b, 1985). Frames are individual and in constant change in each language user, due to the impact from usage events. Natural language learning is triggered by language users being 'showered' by instances of langue use of all kinds, incorporating new conceptual knowledge with current frames. This happens in *ordinary language use*, but also in *terminology learning* in a topical area, and in the linguistic activity of students *elaborating information needs*. All kinds of language processing will trigger, activate, and enrich conceptual frames.

The study consists of two phases, which I will refer to as the *Prearrangement study* and the *Revealment study*, of which the first one was performed as a prerequisite for the second one. The Prearrangement study concerns the *tool* (i.e. the PedNett database made from teachers' word associations and relationship descriptions – collectively referred to as associative data), whereas the Revealment study concerns the *users* (i.e. the students) and their revealment process. Informants were recruited from a course in pedagogy at the Faculty of Education at Oslo and Akershus University College of Applied Sciences.

In the *Prearrangement study* I employed the word association method (Aitchison 2012; Cramer 1968; Deese 1965; Lykke Nielsen 2002) in an effort to collect linguistic expressions of the teachers' knowledge in the topical area of pedagogy. The theoretical basis for the word association method will be thoroughly presented in section 3.3.1, whereas the collection of word associations and relationship descriptions from the teacher informants in the present study will be reported in section 3.3.2. The associative data was used as raw material for a semantic recognition tool (PedNett) which was presented to the students in the Revealment study.

The structuring principle in the PedNett database compiled in the Prearrangement study, is inspired by the way conceptual frames are organized. This is motivated by an assumption that users will gain an easier access to their own vocabulary if they are exposed to a semantic input mirroring the way their own conceptual knowledge is organized. PedNett is not a thesaurus, but an associative semantic network. PedNett differs from a standard thesaurus both when it comes to *terms* and *relationships*: PedNett terms are produced on the spur of the moment in a word association test – contrary to thesaurus terms which are subject to selection criteria and authority control. Each relationship between two PedNett terms is unique and associative, provided as descriptions of the relationship between two terms – contrary to hierarchical relationship in classical thesauri. So whereas the associative structure in PedNett is inspired by conceptual frames, the hierarchical structure of classical thesauri is inspired by the way a topical area is structured in documents, or even by the taxonomy of the topic itself.

The *Revealment study* is the primary study, in which I explore the students' development of their information-based work tasks, and investigate how PedNett might support them in their information need formulation. In the Revealment study, the students worked in the main session with the 8 terminological steps related to a work task, preparing an intended search. In doing so, the students' conceptual frames were used to understand and produce terms, but also to understand the pragmatic context between the given work task and themselves. During this process, their individual frames were both activated and altered, triggered by the terminological activity and also by the interaction with PedNett. Since frames are always understood not only with reference to the conceptual knowledge associated to it, but in the context of the current discourse space (cf. section 2.3.1.1), the students' conceptual point of departure before an eventual search will be different from what it was before the terminological work. The idea of PedNett is both to activate the students' own frames, as well as to enrich their frames with word associations produced by the teachers. The challenge for searchers is to match their own vocabulary with the terminology of the searching system. If PedNett helps students in activating their own vocabulary, they will be better able to face this challenge. The semantic barrier cannot be remedied only by automatic features in the searching systems – the searchers have to take charge themselves, too.

I have included a learning style test in the Revealment study – using a pre-session questionnaire – to be able to relate the students' PedNett use to their learning styles. I chose to use a Norwegian abridged version of the *Approaches and Study Skills Inventory for Students* (ASSIST), translated and validated by Diseth (2001).

The main student informant session (lasting up to 60 minutes) contained two parts: The *first* part was made up by a long session (up to 50 minutes) involving the working at word level with the organization of an assignment and elaboration of an information need in that respect, using *simulated work task situations* inspired by Borlund (2000, 2003). For me to be able to collect comparable empirical data on the students' formulation behaviour *without* and *with* PedNett use, respectively, a laboratory setup with controlled tasks was required. The informant sessions were organized into 8 terminological steps[7], of which the first 5 steps were performed without any semantic input, whereas the last 3 steps were performed while the students were using the PedNett database. In the *second* part of the main session (i.e. the last 10 minutes), the students answered questions in an end-of-session questionnaire on information behaviour and their use and evaluation of PedNett.

In the beginning of the main session, the students were presented with an assignment previously used for an examination in pedagogy. Using pen and paper and guided by a questionnaire, they worked at word level in a stepwise manner with the organization of the

[7] All references to terminological steps will be written as ciphers.

assignment by selecting the work task facets of the assignment (terminological step 1), making a brainstorm (step 2), and organizing the terms from the brainstorm according to the work task facets (step 3). They were then asked to identify which of the topics they needed to acquire more information on (step 4), and then finally which words they would use in a search (step 5). The informants were then asked to enter the PedNett database, enriching or revising the results of each of the main steps – i.e. organization of brainstorm terms (step 6), clarification of information need (step 7), and preparation of an information search (step 8). The empirical data from the main session is made up by a filled-in questionnaire displaying a stepwise elaboration of an information need – before and after PedNett use – together with database logs of each informant's movements in PedNett.

The students' work with the terminological steps served two purposes. Primarily this was done as a way to collect empirical data on the prefocus information need formulation process. At the same time it was used as a prompting activity for the students, in which their vocabulary was activated. I assume that any kind of linguistic activity would work as a terminological trigger, e.g., students discussing their work task with each other, or with the teacher. As my aim was not to test the effect of PedNett use as opposed to other semantic tools – or even as opposed to no semantic input – it was not necessary to measure this trigger effect. However, I will need to be aware of it in the analysis.

I consider this primarily as a qualitative study, and I do not intend to make statistical calculations apart from descriptive statistics. The statistics will be made to get an overview of the empirical data, as a prerequisite for the data analysis. In the analysis I will seek an insight into – and a better understanding of – the elaboration and formulation process of information needs. I will also explore the potentials for word associations in supporting this process. The data material will be coded in an SQL database. In the analysis, my aim is to describe the complexities in the informants' behaviour, and discuss the potential contribution of the kind of semantic help which is represented by the semantic network PedNett.

In traditional retrieval tests, the success of a query is measured by means of searchers' relevance judgements, or according to recall and precision measurements against a test collection evaluated by topical area experts. One might think that I could put up an ideal set of search terms as a standard against which I could evaluate the outcome of the informant sessions. However, this would be inconsistent with the nature of the study. When each informant arrives at a formalized information need, expressed as a set of suggested search terms, this should be viewed in light of which topics they need to acquire more information on, which again is coloured by the topical focus they have made in the organization of the assignment. My aim is to describe what the informants actually *do* – without and with the input from PedNett – as well as study their own evaluation of the potentials of PedNett. In accord with my third sub-question, I will explore how differences in the students' use and evaluation of the semantic network PedNett relate to differences in their learning style, holding the results of the ASSIST test up against the other empirical data. Knowledge about this has implications for system design and information literacy training.

1.7 Practical and terminological issues

Since the empirical data is in Norwegian, examples will be provided in italics, followed by an English translation, e.g., *flerkulturell pedagogikk* 'multicultural pedagogy'. Italics will also be used to emphasize important concepts introduced in the text (e.g., the concept of *revealment*), whereas simple quotes are used when I refer to expressions (e.g., in the discussion of the knowledge gap and 'what you do not know').

All references to numbers of informants, terminological steps, numbers of terms, or age, will be written as ciphers (12 teachers, 8 terminological steps, etc.). All other numbers will be written with letters when it comes to values from zero to nine (two parts of data collection, informants from three classes, etc.), whereas values from 10 and upwards will be written as ciphers.

The store of literature applied in this thesis has been collected over a period of many years. Some monographs have been published in new editions during this time. I have acquired the newest edition only when I have had reason to believe that the changes are relevant to this thesis. For instance, I started off by using Kuhlthau (1993), and acquired the second edition later on (Kuhlthau 2004). If a citation in my text contains references to other authors which I have not consulted myself, I provide a reference to the original source as a footnote.

After the appendices I will provide a combined *glossary and index*, reproducing (snippets of) definitions or explanations as used in the thesis, followed by references to section numbers for further reading.

Some comments on my application of *term, concept, word, vocabulary*, and *terminology* will be useful at this stage: Since the thesis dwells with formulation of information needs, I will often have to refer to linguistic expressions. I will use *term* to refer to the formal expression of a word, and *concept* to refer to the word meaning. *Word* then refers to the compound of expression and meaning. *Vocabulary* will be used to refer to individuals' mentally stored words – as in 'the teachers' vocabulary', or a stock of words used in a as a whole in a given context, e.g., 'the lead-in vocabulary of a searching thesaurus'. A language user's vocabulary is simply conceptual knowledge from the perspective of 'chunks of knowledge' which in a given language community have been given linguistic expressions. *Terminology* is used for linguistic expressions in a topical area as, e.g., pedagogic terminology. So when the students work with the terminological steps, they work with pedagogic *terminology* and as a consequence activate their own *vocabulary*. Terminological knowledge is shared by experts within a topical area. I will use *terminology* and *terms* to refer to this kind of social knowledge (found among experts and in databases and literature in the topical area). The difference between vocabulary and terminology in the context of this thesis is thus that vocabulary refers to a bulk of words – in an individuals' conceptual knowledge, in a thesaurus, or the like – whereas terminology refers to a type of words, like 'agreed-upon terms to be used within a topical area'. When an individual goes from being a novice into being an expert in a topical area, this process involves the acquisition of terminology which has to be integrated in the individual's vocabulary. That is, the terminology has to be stored as conceptual knowledge.

1.8 Structure of the thesis

The rest of this thesis is arranged according to the following structure: In chapter 2 I will present the theoretical framework in which I draw on inspiration from information searching theory, cognitive linguistics, as well as cognitive psychology. The chapter will focus on cognitive aspects of the information need formulation process. Chapter 3 contains theory of method and a description of the data collection for the empirical study. I will also reflect on shortcomings in the research design. The chapter will be structured according to the two parts of the empirical study, i.e. the Prearrangement and the Revealment study. Chapter 4 contains the analysis of the empirical data. The findings will be presented as patterns found in the data, especially concerning learning style, number of terms, and PedNett user types. The analysis chapter will be concluded by a presentation of my findings organized around the three research questions. In chapter 5 I will discuss the empirical results in light of recent research on the Google generation, as well as current information literacy literature. Chapter 6 will contain summary and conclusion for the thesis, as well as reflections on new perspectives. For readers familiar with the IMRAD structure (i.e. Introduction, Method, Results, And Discussion), we see that chapters 1 and 2 parallels the Introduction in IMRAD, whereas chapter 3 equals Method, chapter 4 parallels Results, and chapters 5 and 6 make up the Discussion.

The relationships between the theoretical framework, empirical setup, analysis, and discussion of the thesis are presented in figure 1.1 at the end of this section. This figure illustrates the two parts of the empirical study; the Prearrangement study, and the main data collection called the Revealment study. The subsequent analysis and discussion in chapters 4 and 5 concerns only the Revealment study, as the outcome of the Prearrangement study – the PedNett database – was only used as a tool in the main data collection. Theory of method used in the empirical study is presented in the introductory parts of subsections 3.3 (the Prearrangement study) and 3.4 (the Revealment study). The theoretical framework presented in chapter 2, embraces the empirical study and motivates the analysis and discussion in chapters 4 and 5, cf. the outer arrows in figure 1.1 on the next page:

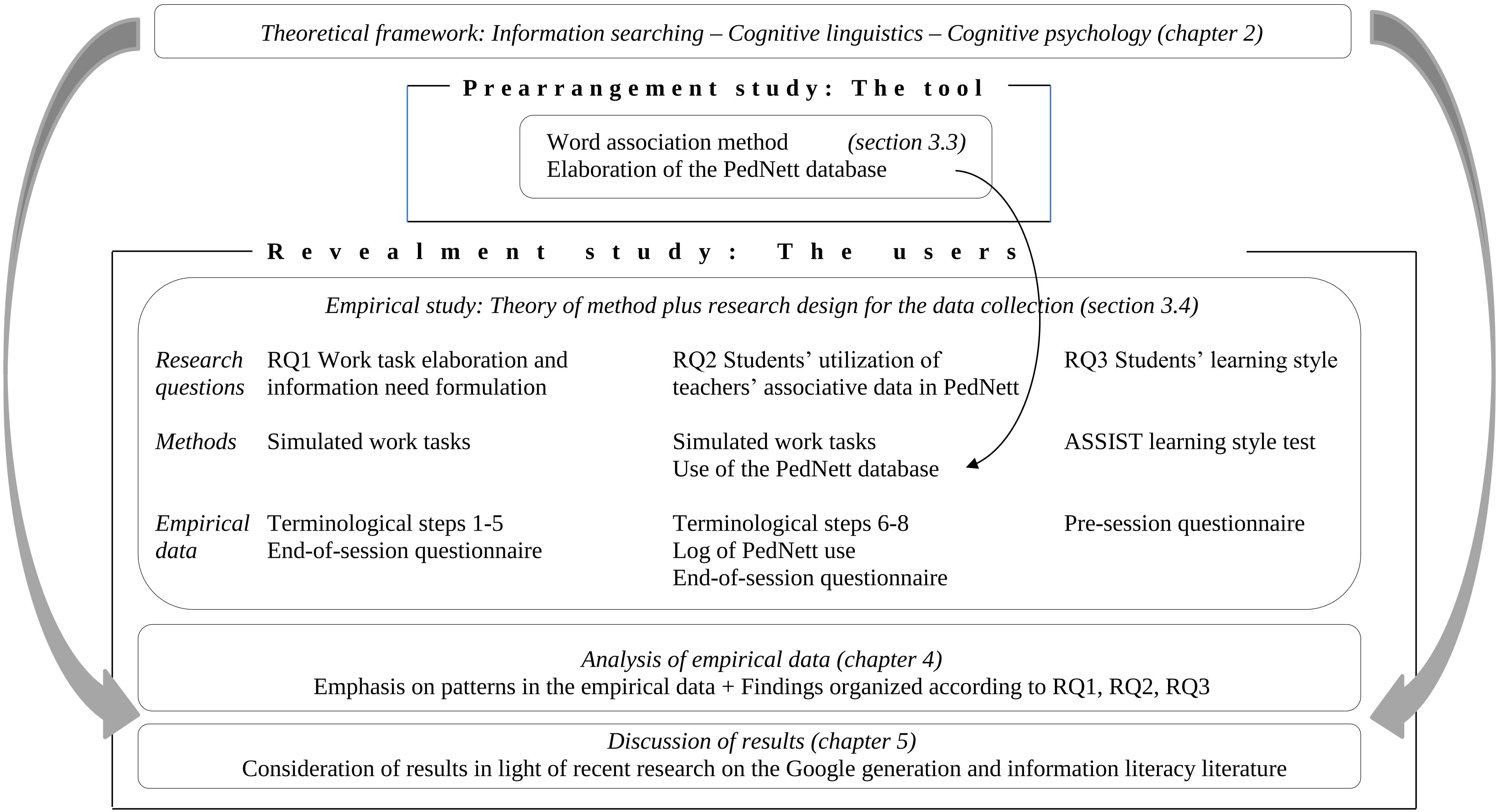

Figure 1.1 Layout of theory, empirical study, analysis and discussion

Chapter

2

Theoretical framework: Formulation of information needs

2.1 Theoretical approach and area of application: Introductory remarks

I have chosen an interdisciplinary approach to my research topic. I will use information searching theory, cognitive linguistic theory, and cognitive psychological theory in an integrated approach to various aspects of the topic, i.e. formulation of information needs. The use of perspectives from linguistics and psychology can enrich our understanding of cognitive aspects of this topic. Enriched knowledge of the prefocus stage of students' elaboration of information-based work tasks, will provide useful information for the development of built-in semantic tools in searching systems. It is also an important input for information professionals in their information literacy training for students. I will not present each of the three theoretical frameworks separately, but approach the topic of information need formulation from the following perspectives: the information search process, representation and activation of conceptual knowledge, psychological factors involved in information need formulation, and finally an integration of perspectives on meaning, information, and knowledge. These components make up the theoretical framework which will motivate the research design, and which will be used in the analysis and interpretation of the empirical data.

As a point of departure concerning information searching theory, I will present three models of information searching, with an emphasis on Kuhlthau's (2004) six stage *Information Search Process model* (cf. section 2.2.1). These will be used as an inspiration for my own research design (chapter 3), in which I will establish 8 terminological steps to collect empirical data on the prefocus stage of information-based work tasks. In section 2.4.3 we will see how Cole (2012) relates his theory of information needs and information searching in the prefocus, focusing, and post-focus stages to Kuhlthau's model.

In order to study how students reveal and formulate their information needs prior to search onset, it is necessary to study the cognitive context of this process. Students are in a situation in which they have to acquire terminological competence and conceptual knowledge in a topical area which is new to them. A bit further down the line, they have to enrich their current knowledge in the topical area and 'struggle their way' into an improved and deeper understanding of the context of the topic they are elaborating. When they are faced with study assignments as part of their educational program, they have to handle information needs requiring a terminology which is not properly *entrenched* in their vocabulary. *Entrenchment* is associated with frequency of use. A word is entrenched as part of a persons' conceptual knowledge by repeated use, and the unit decays if it is not exploited (Schmid 2007). I will use some central perspectives from cognitive linguistic theory to describe the acquisition, organization and activation of conceptual structures (Langacker 1987, 1991, 2007, 2008; Evans & Green 2006; Taylor 2002). This theory will be used to analyse and understand how students cope with the terminological and conceptual challenges in the prefocus stage.

Knowledge organization principles (e.g., in thesaurus construction) are traditionally based on a language-internal approach in which meaning is studied as semantic relationships between units in the mental lexicon. The mental lexicon is "the word-store in the human mind" (Aitchison 2012:4). In the language-internal approach to meaning, the lexicon is structuralistic, meaning that each unit is defined by the distance to other units in the structure. A word gets its meaning by relating it to other words. The language-internal approach is discussed further in section 2.3.2.

The present project, in contrast, applies a conceptualistic approach to the study of meaning, in which words are interpreted in relation to conceptual knowledge (as opposed to a language-internal approach with words interpreted structurally relative to each other, as in thesaurus construction). The conceptualistic versus the language-internal approach to meaning will be thoroughly presented in section 2.3.2. In the presentation of central perspectives in cognitive linguistic theory, I will arrive at the concept of *frames* as the basic theoretical construct in the interpretation of the empirical data. This will be based on Fillmore's (1975, 1977a, 1977b, 1985) frame semantics. Frames provide a theoretical approach to the representation of conceptual structures which is in accord with a conceptualistic understanding of linguistic meaning potential. In section 2.3.1.4 I will provide an example of the use of frames in information science, based on Cole (2012).

During the revealment process – when the students elaborate their information needs and their information needs become more and more clear to them – psychological as well as linguistic processes are triggered. To be able to analyse and understand the empirical data with this perspective in mind, I will present some psychological mechanisms which are on the scene in connection with prefocus information need formulation, primarily based on Anderson (2000), Eysenck (2001), and Reisberg (2001). Examples of such mechanisms are recognition versus recall in the retrieval of memory, and causes of recall problems. These psychological mechanisms, together with the basic tenets from cognitive linguistics and information searching theory, have motivated the research design of the present project.

The rest of chapter 2 is arranged as follows: First, I will present three examples of models of the information search process (cf. section 2.2). I will then approach the topics of representation of conceptual knowledge (2.3) and knowledge formation in information need formulation (2.4), aiming at an integration of cognitive linguistic theory and information searching theory. Subsequently I will look into some psychological factors which are involved in information need formulation (2.5). In section 2.6 I will try to integrate the perspectives of meaning, information, and knowledge presented in the theoretical framework, before I sum up this chapter (2.7). Several concepts are introduced in the course of this chapter. Readers who want to check definitions or explanations as used in this layout, are referred to the combined glossary and index, starting at p. 411.

2.2 Models of the information search process

As my centre focus is on how students are cognitively revealed during information need formulation in the prefocus stage of information searching, I find it useful to look at what existing models claim about this stage. The information search process contains one or several search tasks, and the whole information search process is embedded in a work task (Byström 2002). I want to study a sub-part of students' work task process, more specifically the prefocus stage of the information search process. Therefore I will investigate how the prefocus stage is presented in three models, the *Information Search Process model* by Kuhlthau (1993, 2004), the *Guided Inquiry model* by Kuhlthau, Maniotes & Caspari (2007), and the *Pathways to Knowledge model* by Pappas & Tepe's (2002). The first of these models, the *Information Search Process model*, was first published in 1993 and is widely used in information searching research. It is included here because most other models refer to Kuhlthau's model as a 'golden standard'. The next one, the *Guided Inquiry model*, is included here because it integrates the *Information Search Process model* into an instructive framework for the whole process of work task elaboration. The *Pathways to Knowledge* model is presented here because it includes a *presearch stage* which contributes in our understanding of the information need formulation process prior to search onset. These models are all based on a *process approach to learning*. I conceive of the stages presented in these models as non-linear, iterative activities or strategies for action in a work task process, rather than stages performed in a chronological order. Thus, each activity can occur several times, and at any moment during a work task.

In all three models, searching activities are assigned to the stages called *prefocus exploration* and *focus formulation* (also referred to as *presearch* versus *search* stages). This is useful in preparing my research design because I want to collect data specifically on the students' cognitive challenges in the prefocus stage, unaffected by search results (cf. discussion in sections 1.5-1.6). In a real-life setting in today's digital environment, information searching takes place in all the stages of the work task process. It starts with exploratory searching and ends up with the searching for more pertinent information. The information search process in all its varieties is a heuristic process rather than a step-by-step progression (Cole 2012; Kuhlthau 2004; White & Iivonen 2002).

2.2.1 The Information Search Process model (Kuhlthau)

Kuhlthau's (1993, 2004) *Information Search Process* is a six stage model of information seeking and searching behaviour, describing how students' information search process in information-based work tasks typically evolves. Despite its name, this model deals with the whole work task process, not only the search task. It is aimed at students as well as children and employees. The model is based on research on students' information behaviour during work tasks in association with their studies. It describes information seeking commonly experienced during complex tasks requiring extensive research and significant learning aimed at a deep understanding – as opposed to fact finding. The model explains *affective* (feelings), *cognitive* (thoughts), and *physical* (actions) aspects of the information search process.

The Information Search Process is in accord with a constructivist approach to learning (Kuhlthau 2004). This implies that instead of passively receiving information, the students are involved in an active process of meaning and knowledge construction during their information-based work tasks, a process which is aimed at a deep understanding of the topic under study. The model is presented below:

Tasks	*Task initiation*	*Topic selection*	*Prefocus exploration*	*Focus formulation*	*Information collection*	*Search closure/ Presentation*
Feelings (affective)	uncertainty	optimism	confusion/ frustration/ doubt	clarity	sense of direction/ confidence	satisfaction or disap-pointment
Thoughts (cognitive)	vague →			focused →	increased interest	
Actions (physical)	seeking relevant information exploring →				seeking pertinent inform. documenting	

Figure 2.1 Model of the Information Search Process (Kuhlthau 1993:43, 2004:82)

We note that the Information Search Process model describes six stages: task initiation, topic selection, prefocus exploration, focus formulation, information collection, and search closure. These stages illuminate the students' perspective of information seeking. Each of the six stages is associated with particular feelings, thoughts, and actions. Stage three, e.g., involves the feelings confusion, frustration, and doubt, as well as vague thoughts, and the actions of exploratory seeking for relevant information.

In the Information Search Process model, the seeking of meaning through information is essential. The motto is that "learning begins with uncertainty and is driven by the desire to seek meaning"[8]. The uncertainty initiates the process of information seeking. The findings of Kuhlthau's studies of the information search process are articulated as a *principle of uncertainty* for library and information science:

> Uncertainty principle: Uncertainty is a cognitive state that commonly causes affective symptoms of anxiety and lack of confidence. Uncertainty and anxiety can be expected in the early stages of the information search process. The affective symptoms of uncertainty, confusion, and frustration are associated with vague, unclear thoughts about a topic or question. As knowledge states shift to more clearly focused thoughts, a parallel shift occurs in feelings of increased confidence. Uncertainty due to a lack of understanding, a gap in meaning, or a limited construction initiates the process of information seeking. (Kuhlthau 2004:92)

An uncertainty principle has been proposed by several researchers. Bates (1986) – in her design model of subject access in online catalogues – recommends three design principles: *uncertainty, variety,* and *complexity*. Bates maintains that due to the individual variation in human mental associations and thoughts, an uncertainty principle has to be posited. Indexing

[8] Cited in Kuhlthau, Maniotes & Caspari (2007:17), with reference to Kuhlthau's (2004:89-105) chapter on the uncertainty principle, described later in this section.

behaviour and information searching behaviour are always infinitely complex. They will never match the mechanistic assumption that there is an ideal indexing system containing perfect descriptions of document contents which in turn will provide ideal matches with users' expressed information needs. This relates to the different perspectives of information needs and system feedback represented by computer science and information science according to Cole (2012), cf. section 2.4.3. My motivation for exploring students' potential benefits of using a semantic tool like PedNett, is an assumption that this associative network can be used as an idea generator for search term candidates, in an effort to narrow the gap between information needs as expressed by the users, and information as represented in a searching system.

The research design of the present project is aimed at collecting information related to the first four stages of the Information Search Process model, primarily stage three (prefocus exploration) and four (focus formulation). In these stages the students typically go gradually from a vague cognitive state into a more focused state, and affectively from confusion to more clarity. My informants are presented with an information-based work task for which they have to arrive at their own focus, and during the informant session (mirroring the prefocus stage) they experience some level of uncertainty. It is important to remember that in a real-life setting, an information search process in connection with the work on a student assignment is a back-and-forth process along Kuhlthau's six stages. My main data collection was done in one session per informant, trying to capture the terminological challenge affiliated with the organization of a new assignment and the clarification and formalization of the information need enforced on that occasion.

Stage four in Kuhlthau's (2004) model, focus formulation, is not only about formulating search terms (as my student informants are instructed to do) – in a real-life setting it is also about formulating an approach to the research problem. The revealment of a focus comes gradually during prefocus exploration and focus formulation, i.e. stage three and four. There are several layers of challenges included in the focus formulation. The students have to personalize their topic by forming their individual perspective within the work task requirements. By reading notes, reflecting, discussing, and writing they have to identify and select ideas within their chosen focus. Kuhlthau (2004:48) stresses the importance of focus formulation in stating that "[w]hen individuals do not form a focus during the search process, they commonly experience difficulty throughout the remainder of the search and when they begin to write or present findings". In section 2.4.3 I will relate Kuhlthau's six stage model to

Cole's (2012) theory of information needs, linking information searching and knowledge formation.

2.2.2 The Guided Inquiry model (Kuhlthau, Maniotes & Caspari)

Several information literacy acquisition models have been made inspired by Kuhlthau's Information Search Process. Kuhlthau herself is involved in one of them, the *Guided Inquiry* model (Kuhlthau, Maniotes & Caspari 2007). It is intended for project-based teaching and provides a tool for *inquiry learning* (also called problem based learning). The Guided Inquiry model is intentionally aimed at primary and secondary school education. However, the model is highly relevant for university college students, too, as inquiry learning permeates the whole educational system. Accordingly the name of the model, in which *guided* refers to the role of the instructional team around the students (teachers, librarians, etc.), whereas *inquiry* refers to the fact that the model is based on inquiry learning (as in project-based teaching).

Project-based teaching with inquiry learning is a method developed within the constructivist approach to learning (Kuhlthau, Maniotes & Caspari 2007). This implies involving the students in an active process of meaning construction, as opposed to the traditional transmission approach in which learning is viewed as something the teacher or text 'does' to the student – i.e. feeding the student with information. The model "creates an environment that motivates students to learn by providing opportunities for them to construct their own meaning and develop deep understanding" (Kuhlthau, Maniotes & Caspari 2007:6). The constructivist approach maintains the students' perspective of the constructive process of learning from a variety of sources.

The Guided Inquiry model sees the information search process as an essential part of the whole learning process. Thus, the Information Search Process model of Kuhlthau (2004) is integrated in the Guided Inquiry model, and in this setting it also includes a seventh stage: initiation, selection, exploration, formulation, collection, presentation, and *assessment*. The assessment stage is characterized by a sense of accomplishment and increased self-awareness. It is critical for students to learn to manage the exploration and formulation stages of information searching (i.e. the third and fourth stages) using advanced information technology. "In fact, advances in information technology have made the exploration and formulation stages more difficult for students to work through on their own and more critical for them to learn to manage" (Kuhlthau, Maniotes & Caspari 2007:18).

It is important to point out that working on an assignment is not a linear process, but involves a back-and-forth movement along the seven stages. My informants elaborate their information needs in the first four stages, prior to the collection stage. It is not enough to have a topic (as my students are provided with in the work task assignment) – they also need to have a focus. The prefocus exploration (third) and focus formulation (fourth) stages are difficult, confusing, and an unpleasant surprise for many students – and sometimes for teachers and librarians as well. Kuhlthau, Maniotes & Caspari (2007:17) observe that the students too often "expect to move directly from selecting the general topic for investigation to gathering and collecting information for completing the assignment. [...] However, it is during exploration that the most significant learning takes place in the inquiry process".

When the students have arrived at a focus, they have to formulate an information need within that focus, resulting in query formulations entered into the searching system. The fifth stage, information collection, is the most searching intensive. After a system response, searchers often have to make a revised set of search terms. The students in my empirical study completed 8 terminological steps by arriving at tentative search terms, i.e. initial information need formulations which are not actually entered into a system. In Taylor's (1968) terminology (cf. section 1.2.3) they arrived at a formal statement of their need (the formalized need), but they did not proceed to the compromised need (the question as presented to the information system). Kuhlthau, Maniotes & Caspari (2007) use *term* and *descriptor* about the search terms entered into the information system.

The Guided Inquiry model engages students in their own learning. There are five kinds of learning which the students have to develop. The instructional team should provide interventions at critical learning points. Figure 2.2 displays the kinds of learning and types of interventions:

Interventions for learning in the inquiry process	
Five kinds of learning	*Types of intervention*
Curriculum content	for fact finding, interpreting, and synthesizing
Information literacy	for locating, evaluating, and using information
Learning how to learn	for initiating, selecting, exploring, focusing, collecting, and presenting
Literacy competence	for improving reading, writing, speaking, and listening
Social skills	for interacting, cooperating, and collaborating

Figure 2.2 Interventions for learning in the inquiry process (Kuhlthau, Maniotes & Caspari 2007:141)

Of special interest for the present project, is information literacy learning, as well as the ‘learning how to learn’ point, comprising the whole Information Search Process model. The authors state that the interventions ideally should be provided at the point of use. The use of PedNett in the prefocus stage can be considered as a ‘point of use-intervention’ at a critical learning point, i.e. when the students are at the semantic barrier (introduced in section 1.2.3), struggling to formulate their information needs in a work task context, for them to arrive at search terms candidates for use in online searching.

When students are trained according to the Guided Inquiry model, they ultimately acquire *information literacy* competence. Information literate students are able to access information efficiently and effectively, they evaluate information critically and competently, as well as use information accurately and creatively. So the Guided Inquiry model aims at promoting a high degree of independence in searching for, selecting, and using information – i.e. a focus on *locating*, *evaluating*, and *using* information. In the process of performing these tasks, the students develop a deeper understanding of the topical area under investigation, when they construct their own meaning. Of special importance for the present project, are the indicators for the *locating* requirement for information literacy, concerning efficient information access:

> Indicators: recognizes the need for information; recognizes that accurate and comprehensive information is the basis for intelligent decision making; formulates questions based on information needs; identifies a variety of potential sources of information; develops and uses successful strategies for locating information. (Kuhlthau, Maniotes & Caspari 2007:78)

In the Guided Inquiry model, the students gain an understanding of the following four different types of searches which have different purposes in the inquiry process, and take place in different stages: *preliminary*, *exploratory*, *comprehensive*, and *summary* searching.

Contrary to students' frequent expectations, it is not possible to conduct one all-including search during the work task process. In the empirical study of the present project, the informants elaborated their information needs in the prefocus exploration stage – so the tentative search terms which they came up with, were of the kind which could be used in preliminary and exploratory searching.

2.2.3 The Pathways to Knowledge model (Pappas & Tepe)

Pappas & Tepe's (2002) *Pathways to Knowledge* model is based on Kuhlthau's research preceding the first edition of her Information Search Process model (Kuhlthau 1993). The Pathways to Knowledge model is intended for information literacy training in a framework presupposing online searching. As with the Guided Inquiry model, Pathways to Knowledge is designed as a tool for *inquiry learning* and a constructivist approach to learning (Pappas & Tepe 2002). Characteristic is the focus on a dynamic interaction with information and experience.

Pathways to Knowledge includes a *presearch stage* which resembles the *prefocus exploration stage* in Kuhlthau (2004), in which the students experience a progress from a vague to a more focused cognitive state. Pappas & Tepe acknowledge that information seeking and searching activities are recurring in the work task process. As with the Guided Inquiry model and other inquiry learning models, the Pathways to Knowledge model sees the information search process as an integral part of the whole learning process (Pappas & Tepe 2002:xii): "Process in this context reflects stages or steps that information seekers follow as they identify their information need, then gather, evaluate, organize, and use information".

The Pathways to Knowledge model is composed of six stages: Appreciation, presearch, search, interpretation, communication, and evaluation. Of particular interest for the present project is the description of the *presearch stage*:

> The Presearch stage enables searchers to make a connection between their topic and prior knowledge. They may begin by brainstorming a web or questions that focus on what they know about their topic and what they want to know. This process may require them to engage in exploratory searching through general sources to develop a broad overview of their topic and explore the relationships among subtopics. Presearch provides searchers with strategies to narrow their focus and develop specific questions or define information needs. (Pappas & Tepe 2002:6)

We note the emphasis of connecting the work task topic to the students' current knowledge through linguistic activities like brainstorming and the formulation of questions at various levels of specificity. Another presearch activity includes the identification of tentative search terms. The process of narrowing a work task focus in the presearch stage might involve exploratory searching. So the distinction between the presearch and the search stage in the Pathways to knowledge model is actually a matter of different *kinds* of searching – in line with the preliminary, exploratory, comprehensive, and summary searching types in the Guided Inquiry model.

The fact that both the Pathways to Knowledge model and the Guided Inquiry model are based on methods for inquiry learning, implicates that they emphasize the *process* (rather than its content) and apply a *student-centred* approach. Both models are developed to enable students to learn meaningfully from diverse and complex information sources, and develop information literacy and technology competencies. They are applicable for the whole inquiry learning process, with a search task embedded in an information search process, again embedded in a work task.

2.2.4 Prefocus information need formulation in 8 terminological steps

In section 2.2 I have presented three models of information searching. Kuhlthau's (2004) Information Search Process (2.2.1) is a descriptive model, in contrast to the Guided Inquiry (2.2.2) and Pathways to Knowledge (2.2.3) models, which are instructive models, meant for use in information literacy training and project-based teaching.

It is worth noting that Kuhlthau's (2004) model of the Information Search Process does not have searching in an electronic environment as a requirement. Kuhlthau is an information seeking researcher concerned with information seeking in the library as a resource. When she models the information search process, she refers to the library as a system. The searching stage includes the action "using library to collect pertinent information" (Kuhlthau 2004:49). Admittedly, she discusses challenges for designers of online catalogues, but still, searching means library search, i.e. to use the various sources in the library. This is opposed to the Pathways to Knowledge model (cf. section 2.2.3) which presupposes computer-based searching, and also includes search strategies which apply only in an electronic searching environment.

However, the Information Search Process model is easily adapted to an electronic environment, and is still widely used as a research tool as well as for practical application. Kuhlthau, Heinström & Todd (2008) examines whether Kuhlthau's (2004) Information Search Process is still useful in new, technologically rich information environments. They conclude that the model is still useful in describing students' behaviour in information-based work tasks. Both the Pathways to Knowledge model and the Guided Inquiry model instantiate a KWL framework ('know-want-learned') which helps the students reveal 'What do I *know*?', 'What do I *want* to know', and 'What did I *learn* about the topic?' – thus applying the principle that the point of departure for all learning should be the students' current knowledge.

The research design of the present study is meant as an impetus to reveal information concerning the first two questions, during 8 terminological steps (cf. the Revealment study presented in section 3.4): *selection* (step 1), *brainstorming* (2), *structuring* (3), *clarification* (4), *formulation* (5), *structure revision* (6), *clarification revision* (7), and *formulation revision* (8). These steps are inspired by the description of the prefocus stage in the three models presented above in this section, as well as Cole's (2012) information need theory (cf. section 2.4.3 below). The terminological steps are also compiled to make explicit and collect data on a process which is often wholly or partly tacit in the students – for me to be able to study the prefocus information need formulation process, and to be able to compare formulation behaviour *without* and *with* PedNett use. Thus, steps 6-8 parallels steps 3-5, in that the students structure their brainstorm, express their information need, and formulate tentative search terms, first without semantic input, and afterwards in using PedNett.

2.3 Representation of conceptual knowledge

In this section I will examine the cognitive context in which students reveal and formulate their information needs, with a cognitive linguistic approach. When I investigate the knowledge formation process in the prefocus stage, I need to make explicit how conceptual knowledge is represented in the mind, within the framework I use. When students work with information-based work tasks, they have to acquire terminology in a topical area which is fairly new to them. Cognitive linguistic theory provides a framework for the understanding of how conceptual knowledge is represented in the mind. It is dynamic in the sense that it is in continuous change when information is added, repeated or adjusted, as each individual continually abstracts information from experience with the surrounding world through the senses, speech, and reflection (Evans 2006). The assumption that meaning is conceptual implies that words cannot be understood isolated from larger conceptual knowledge structures. Below I will present Fillmore's (1975, 1977a, 1977b, 1985) *frame semantics,* which is a model based on the conceptualistic approach to the understanding of meaning.

2.3.1 Frames (Fillmore)

Frames were briefly introduced in chapter 1 as the amount of conceptual knowledge making up the context of a word. A frame cuts out a chunk of conceptual knowledge which is relevant for the interpretation of language use in a given situation. I intend to use the concept of frames as a motivation factor in the research design, and as the main approach to the understanding of the empirical data in this project. Frames are individual in each language user, and in constant change due to the impact from usage events. These are characteristics which are in accord with the situation of students developing conceptual knowledge in a topical area in connection with information need elaboration.

2.3.1.1 Examples from the literature on frame semantics

Let us first consider *the restaurant frame*, which is assumingly the most common example used in descriptions of Fillmore's frame theory. Several *verbs/actions* are associated with 'the restaurant frame' (making an order, eating, having a conversation, etc.), as well as *roles* (waiter, cook, restaurant guest, etc.), and *objects* (menu, food, drink, check, cutlery, napkins, etc.). The actions, roles, and objects are related to each other by 'the restaurant frame', and the activities of ordering, eat, converse, etc., are understood within the context of the conceptual knowledge associated with this frame. This includes scripts for playing out the roles associated with the frame. So 'the restaurant frame' cuts out the amount of conceptual knowledge which is relevant for the interpretation of language use in the context of being in a restaurant.

Fillmore demonstrates that the understanding of the meaning of single words is often related to groups of words. The words form groups like *father, mother, son, daughter, brother*, and *sister*, or *buy, sell, pay, spend*, and *cost*, and these are learnt relative to each other. "What holds such word groups together is the fact of their being motivated by, founded on, and co-structured with, specific unified frameworks of knowledge, or coherent schematizations of experience, for which the general word *frame* can be used" (Fillmore 1985:223, my emphasis).

An example concerning Norwegian compound nouns can illustrate the matter further. Norwegian is a head-final[9] language, so the word *spisebord* ('eat – table', i.e. dining table) is

[9] Head-final implies that compounds have the main component (the head) in the final position, after an attribute. For instance, *spisebord* is composed by the attribute *spise* ('eat') and the head *bord* ('table'). The head decides the word class affiliation, in this case a noun. An example of a head-first language is French – cf., e.g., *table de famille* ('table – family', i.e. eating table).

necessarily a table – but the interpretation of the first part of the compound, eat, is done in relation to the associated frame – we don't eat tables; we sit at tables while we are eating. Similarly, *spisepause* ('eat – break', i.e. meal break) is a break which is meant as a time for eating. But frames are not only understood with reference to the conceptual knowledge associated to it, but in the context of the *current discourse space*. All words, semantic structures and relationships, as well as grammatical rules, are abstracted from usage events, evolving in the *current discourse space* (Langacker 2007; 2008). The interpretation of each usage event is done in the context of previous and anticipated usage events. (Langacker's concept of the current discourse space implies a speaker and a hearer. He defines the current discourse space as "everything presumed to be shared by the speaker and hearer as the basis for discourse at a given moment" Langacker 2008:281). When compound words in Norwegian are used with another interpretation than the conventional one, the new meaning is contributed for the present context. Hence, if a child asked for some food shortly after a meal, the parent could decline, saying that there is a *spisepause*, in the meaning 'a break from the meal/food serving situation', which would be understood in the given context, as a humoristic instance of language use.

2.3.1.2 Frame knowledge expressed as word associations and relationship descriptions

Conceptual frames can exist on any degree of complexity, and be related to concrete or abstract matters. When students work their way into a topical area which is new to them, their knowledge formation process can be described as the acquisition and enriching of conceptual frames. In my second research question I ask "How do students in the prefocus stage utilize teachers' frame knowledge expressed as word associations and relationship descriptions in the semantic network PedNett?". In this section I will present some examples of associative data produced by the teacher informants (cf. figure 2.3-2.5 below). The purpose of this is to illustrate how I apply the concept of frames in the motivation of the research design, and in the interpretation of the empirical data. My aim is to make a tight integration of theoretical approach and analytical use, and the following examples provide samples of the kind of data which is subject to a frame semantic investigation in the present project. Let us first look at how the teachers' frame knowledge is expressed in the word association test of the Prearrangement study (which will be presented in full in section 3.3).

In the informant sessions, the teachers were presented with a stimulus word for which they first produced word associations, followed by descriptions of the relationship between each pair of stimulus and response word. Eight teachers were primed with the stimulus word *læring* 'learning'. Each set of response words provided by the teachers were unique, but some of the responses were provided by several informants. *Læring* also occurred as response words with respect to other stimuli words. In figure 2.3 below, I try to illustrate this by presenting stimuli/response words to *læring* according to frequency. The innermost circle represents the most frequent word co-occurring with *læring* in the word association test, i.e. that of *lek* 'play', occurring 5 times with *læring*. The two words in the middle circle occurred 4 times each with *læring*, whereas the words in the largest circle occurred 2 times each with *læring.* Outside the circle are unique associations to *læring* – so they have only one relationship description each. The empirical data were produced in Norwegian, but is translated by me in the illustration and subsequent text. Appendix 10 displays the PedNett cluster for *læring*. (I use *PedNett cluster* to refer to a PedNett entry term, plus the sum of its associated words and their relationship descriptions). All the words associated with *læring* are displayed in the figure below:

Figure 2.3 Stimuli/response words to *learning* produced by 8 teacher informants

The words associated with *learning* in the word association test can be understood as linguistic expressions of frame knowledge. When associations from different stimuli words overlap, we might consider this as an indication of conjoining frame knowledge. In one of the simulated work tasks used in the Revealment study, the students were instructed to discuss the role of *motivation* with respect to *learning*. Now let us look at the word associations provided by the teacher informants for *motivation* and *learning*, and the word most frequently associated with learning, i.e. *play*. In figure 2.4 below I have tried to illustrate how the *PedNett clusters* for these three words overlap. I have included all the overlapping words, but only examples of non-overlapping words in the three clusters:

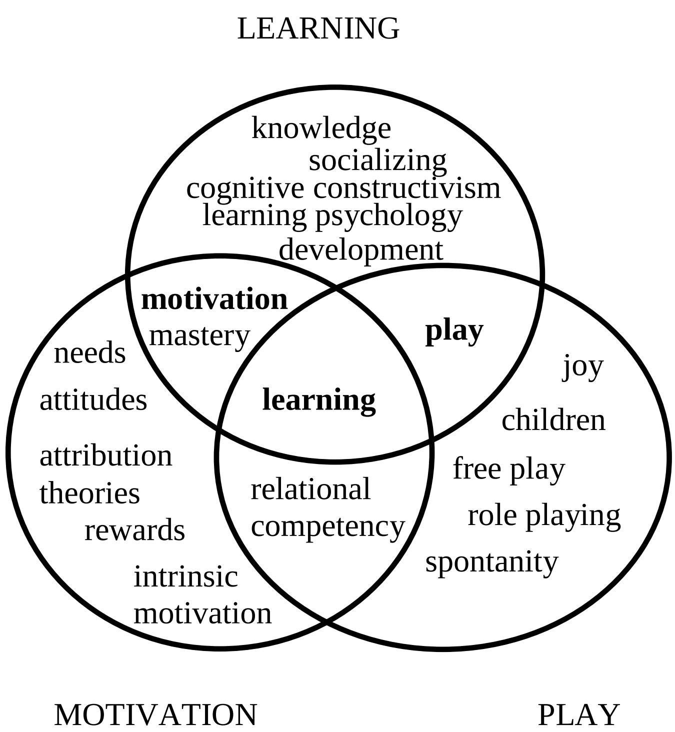

Figure 2.4 Visualization of overlap between three PedNett clusters

We note that a word might occur in several PedNett clusters, hinting at overlapping frame knowledge. This knowledge is not only a network of items (words), but a network of knowledge about how these items relate to each other. The intention of the semantic network PedNett is accordingly not only to illustrate that words might take part in different frames, but to give indications of *how* they are related – inspired by the understanding of frames. This is done by relationship descriptions, which are descriptive texts explaining the relationship between each pair of words (cf. section 3.3.2). In a thesaurus, associative relationships are expressed by the unspecified formal relationship ‘related term’ (RT). The relationship descriptions in PedNett are made in an attempt to verbalize in which way associated words are related to each other. Now let us look at the relationship descriptions provided by the teacher informants for the word pairs *learning – motivation*, and *learning – play*, respectively (*motivation* and *play* were not associated with each other, accordingly they have no relationship descriptions in the illustration below), cf. figure 2.5:

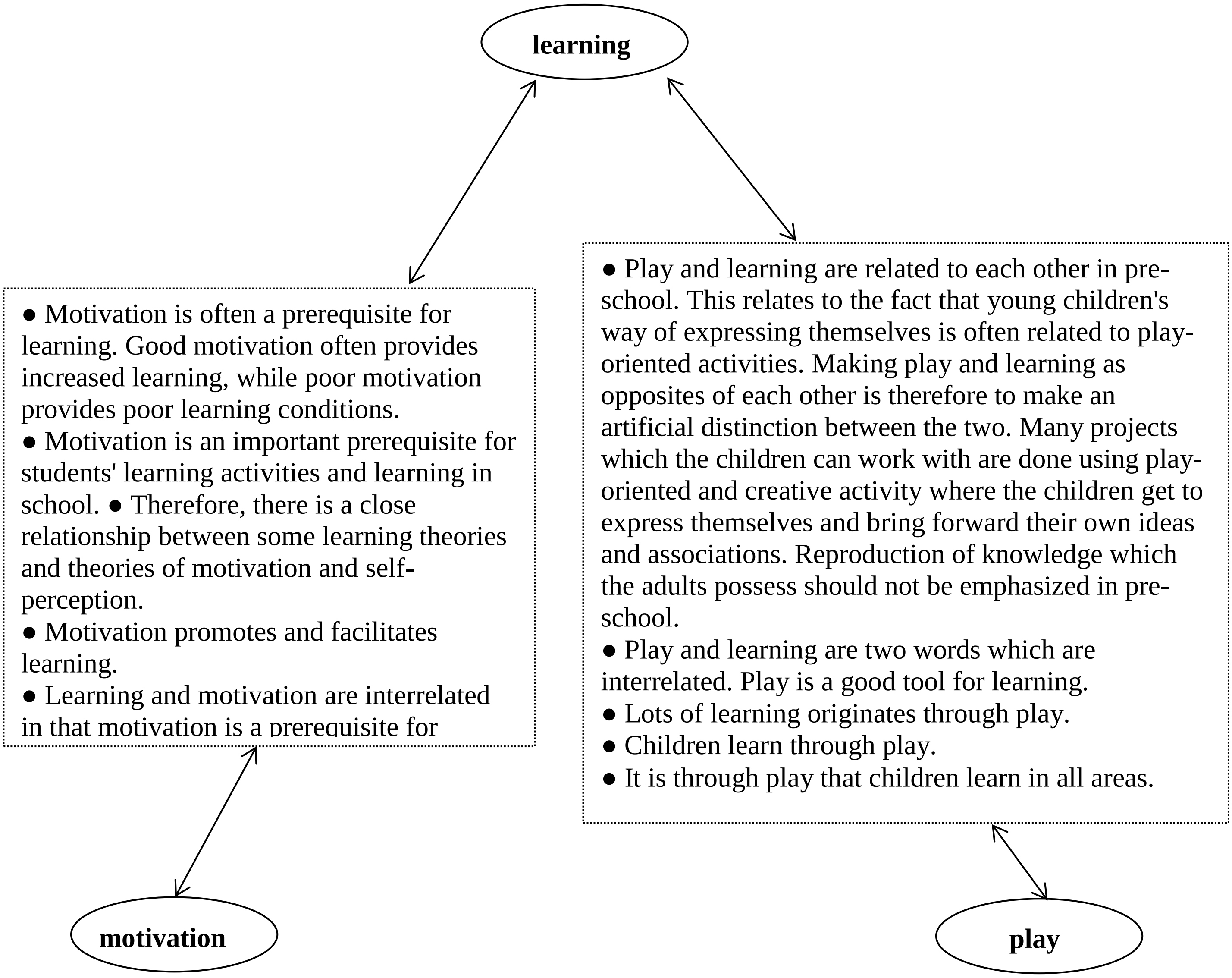

Figure 2.5 PedNett relationship descriptions between two pairs of stimulus-response words

Note that the examples of word associations and relationship descriptions in figures 2.3-2.5 above are *not* frames as such – for several reasons. For one thing, frames are *mental constructs* of conceptual knowledge, not written instances of language use. Second, frames are *individual* – not collective, as the sets of relationship descriptions presented above. Third, frames are *complex,* containing an endless amount of usage-based meanings, relationships and experiences. The associative data produced as word associations and relationship descriptions are incomplete and produced at the spur of the moment in a laboratory setting. All these things being said, I still find it useful to try to 'tap' some frame knowledge from topical area experts (the teachers), to be able to explore how novices (the students) might benefit from this knowledge when they elaborate information needs as a part of their work tasks.

Now, what are the similarities and differences between PedNett and a thesaurus using classical thesaurus relationships? Let us parallel PedNett with the ERIC thesaurus[10] containing terminology for educational science for the entry term *learning*. In searching the ERIC thesaurus, the user is presented with 29 narrower terms displaying different types of *learning,* e.g., *discovery learning, electronic learning, mastery learning, nonverbal learning,* and *problem based learning*. The entry *learning* has no broader terms, but two synonyms, i.e. *knowledge acquisition*, and *learning characteristics*. Furthermore, a list of 26 related terms are provided: *advance organizers, aptitude, cognitive processes,* etc. In electronic thesauri there can be a rich selection of related terms – as opposed to previously paper-based thesauri or other subject indexes in which there had to be restrictions as to which related terms one should include, due to considerations of space.

There is some partly overlap between related terms in ERIC and PedNett on the entry for *learning,* e.g., *knowledge level* and *constructivism (learning)* in ERIC resembling *knowledge* and *cognitive constructivism* in PedNett. However, the two sets of related terms are rather different, e.g., we do not find the PedNett terms *play, mastery, socializing, learning sociology*, *formation*, and *attitudes* among the related terms for *learning* in ERIC. The reason for this difference lies in the different sources for each of these tools – ERIC as a thesaurus is based on literary warrant, whereas PedNett is based on associative data provided by topical area experts.

What can we learn from the above demonstration of how associative data are represented in PedNett, and the subsequent comparison with ERIC? My aim has been to illustrate how I intend to use word associations and relationship descriptions as linguistic

[10] The ERIC thesaurus is compiled by The Education Resources Information Center, cf. http://eric.ed.gov/.

representations of (abstracts of) teachers' frame knowledge. This is done in an effort to elaborate a semantic network (PedNett) which is tentatively based on theories about how conceptual knowledge is represented in people's minds. The intended use of PedNett is to present the student informants with a terminological idea generator specifically complied for use in the prefocus stage of information-based work tasks.

2.3.1.3 Theoretical layout of frame semantics

In the two previous sub-sections I have tried to demonstrate the usefulness of applying frame semantic theory as a motivation for the research design in the present project. Let us now have a closer look into what this theory claims about how conceptual knowledge is represented and enriched during the knowledge-formation processes.

In frame semantics, the meanings of words are made up by their relationships to conceptual knowledge, i.e. knowledge about *words* integrated with knowledge about the *world*. We call this frame knowledge. The frame model of conceptual knowledge is based on a conceptualistic view of meaning (which will be contrasted to other views of meaning in section 2.3.2), according to which the meaning of an expression is equated with a conceptualization in the mind of a language user. Frames are made up by knowledge which is essential for the interpretation of words in a given context. Frames are conceptual structures made up by knowledge "which is presupposed for the concepts encoded by the words" (Fillmore & Atkins 1992:75). One cannot understand the meaning of a single word without access to all the essential knowledge that relates to that word. "[T]he most useful information about a lexical item is the set of frames in which it plays a role and the position that it occupies in each of these frames" (Fillmore 1977b:132).

We see that frames capture chunks of conceptual knowledge. Words are defined relative to some particular background frame or scene rich with world knowledge. Fillmore stresses that there is no principal difference between the linguistic information about the meanings of words (i.e. lexical knowledge) and real-world information about the properties of things (i.e. encyclopedic knowledge): "... any attempt to relate a person's knowledge of word meanings to a person's abilities to interpret texts will have to recognize the importance of non-linguistic information in the interpretation process" (Fillmore 1977b:133). When words are established as units in the mental lexicon, they are not represented as isolated 'islands', but related to some potential context of use. "[T]he act of lexicalizing something is the act of presenting it as an established category of human thought. If a lexical item exists, in other words, it must exist as some part of a frame and must correspond to some part of a schema" (Fillmore 1977b:135).

In frame semantics, contextual knowledge is a part of the linguistic description. A conceptual frame involves a generalization of some aspect of the world. When a word is used or understood in a given *context*, it activates conceptual knowledge from an associated *frame*. Frames link the analysis of language to the study of cognitive phenomena as they include both linguistic descriptions and characterizations of knowledge structures. Frames are used to understand and produce language, but also to understand the pragmatic context between speaker and receiver in a conversation. Frames are generalizations of experiences (knowledge structures) which are represented on the conceptual level, and are stored in long time memory. They relate units associated with culturally *embedded* scenes or activities connected with human experience.

Fillmore argues that the contextual knowledge is an inextricable part of the linguistic description:

> As an account of the larger understanding process, claims about the importance of knowledge structures can hardly be controversial. What *is* controversial, however, is the suggestion that such knowledge belongs in linguistic description. In frame semantics it is held to be necessary to give an account of such knowledge in describing the semantic contribution of individual lexical items and grammatical constructions and in explaining the process of constructing the interpretation of a text out of the interpretation of its pieces. (Fillmore 1985:233, italics original)

The definition of words on the basis of the context in which they are used, is not a matter of course. In classical Aristotelian categorization, objects are grouped on the basis of likeness. In frame semantics, on the other hand, objects are grouped into frames according to the context in which they occur. "A word or phrase or sentence or text identifies a scene, and it foregrounds, or highlights, some portion of it" (Fillmore 1977b:86). Frames are the linguistic instantiations of situations typically experienced as one context:

> [...] people associate certain *scenes* with certain linguistic *frames*. I use the word *scene* in a maximally general sense, including not only visual scenes but also familiar kinds of interpersonal transactions, standard scenarios defined by the culture, institutional structures, enactive experiences, body image, and, in general, any kind of coherent segment of human beliefs, actions, experience, or imaginings. I use the word *frame* for any system of linguistic choices – the easiest cases being collections of words, but also including choices of grammatical rules or linguistic categories – that can get associated with prototypical instances of scenes. (Fillmore 1975:124, emphases original)

Each word can be a part of several frames, depending on the context of use. The understanding of a word thus represents the recognition and activation of the relevant frame(s), depending on the scene in a given situation. "A word appearing in a text that is being interpreted by someone who understands the word can be thought of as activating a scene and pointing to a certain part of that scene" (Fillmore 1977b:84). This recognition of a scene in a given context in turn activates the relevant frame(s). To sum up, contextual knowledge is obligatory in the interpretation of usage events. Words are always understood relative to a context of general and contextual conceptual knowledge activated by a usage event in a given situation.

2.3.1.4 The use of frames in information science

In section 1.2.3 I mentioned Cole's (2012) theory of information needs linking information searching and knowledge formation. In his theory Cole (2012:ch. 6.3) integrates the 1975 frame theory of Minsky, a cognitive scientist who was working with artificial intelligence.[11] Fillmore was familiar with Minsky's work[12] and ascribes the idea of frames to him and even back to Bartlett in 1932 (Fillmore 1975:124): "The frame idea, under various names, goes back at least as far as the 'schema' idea of F. Bartlett (1932)[13] and has many realizations in work on artificial intelligence, most elaborately in M. Minsky (1974)". Cole (2012) also refers to Bartlett (1932) – so Cole's application of frame theory goes back to Bartlett via Minsky, whereas my application of frame theory goes back to Bartlett via Fillmore. Cole's application of Minsky's frame theory is compatible with my application of Fillmore's frame theory.

Cole applies Minsky's frame theory to concretize his discussion of information use and its relation to information needs:

> Minsky utilizes real-life examples to explain how humans are able to navigate through their physical and social environments. [...] Minsky divides our internal model of the world into units called frames. A frame is a chunk of knowledge, a type of knowledge structure like a schema. [...] Minsky emphasized • How the frame creates expectations about what will be perceived in the environment based on past experience with similar environmental conditions. • How the frame receives incoming environmental stimuli. • How the frame uses the incoming environmental stimuli to adapt to the particulars of the environment in front of it at a given moment in time. (Cole 2012:40)

Cole provides the following frame theoretical perspective of how novices have to attach an information need to their current knowledge:

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[11] Cole's (2012) primary sources on Minsky's frame theory (not consulted by me), are: Minsky, M. (1975). A framework for representing knowledge. In P.H. Winston (Ed.), *Psychology of computer vision* (pp. 211-277). New York: McGraw-Hill. And: Minsky, M. (1980). A framework for representing knowledge. In D. Meting (Ed.), *Frame conceptions and text understanding* (pp. 1-25). Berlin: Walter de Gruyter.

[12] Fillmore (1975) refers to: Minsky, M. (1974). A framework for representing knowledge. In *Artificial intelligence memo*, no. 306. MIT: Artificial intelligence laboratory. Fillmore (1985) refers to Minsky, M. (1975). A framework for representing knowledge. In P.H. Winston (Ed.), *Psychology of computer vision* (pp. 211-277). New York: McGraw-Hill.

[13] Primary source, not consulted by me: Bartlett, F.C. (1932). *Remembering*. Cambridge, U.K.: Cambridge University Press.

> In the case of information need for domain novices conducting an information search utilizing an information system, their knowledge about the topic, their state of readiness concerning information about the topic, and their expectation set concerning the topic must be updated for this essential adaptation to take place. Let us consider users' knowledge about the new topic to be a frame; their information need is governed by that frame. In Minsky's frame theory, there are slots at the bottom of the frame representing properties, dimensions, or elements of the overall topic frame for users, and these slots with their conditional state of readiness give the perceptual/cognitive system of individuals an adaptive propensity. (Cole 2012:44)

Cole introduces the concept of *Association Wheels* in his application of frame theory on the process of knowledge formation during the elaboration of information-based work tasks. The association wheels symbolically represent the users' associative chunks of knowledge or *frames network* stored in memory. Several times Cole uses Association Wheels interchangeably with *information need frame*:

> "[H]umans are guided in their flow through the environment by frames or some other kind of structure that unifies our perceptual and cognitive interaction with the environment and the world. These Association Wheels form the user's memory structure in a linked network of concepts. When the user is in a Pre-focus information search, the user does not have a strong Association Wheel or information need frame, so a more general topic has to suffice until focus is reached and a strong Association Wheel information need is instantiated". (Cole 2012:132-133)

I will have a closer look at Cole's theory on information needs in section 2.4.3 on knowledge formation in information searching.

In the empirical study presented in the subsequent chapters, *frames* make up the basic theoretical construct in the application of cognitive linguistic theory in the interpretation of the empirical data. I use *frame knowledge* in referring to conceptual knowledge making up the context for a word (e.g., "I consider word associations to be one way to reveal aspects of the frame knowledge attached to words") or a set of work task facets (e.g., "Frame knowledge is changed and accumulated throughout the information need formulation process"), whereas I use *conceptual knowledge* as a more general term (e.g., "Students in the process of acquiring an understanding of a topical area which is new to them, experience a constant change in their conceptual knowledge"). I will use these concepts in the understanding and analysis of the empirical data, and in the discussion of my research questions.

2.3.2 Three different approaches to meaning

We have seen that an understanding of acquisition, organization and activation of conceptual structures is a prerequisite in the investigation of knowledge formation in the prefocus stage. *Knowledge* can be understood as *information* given *meaning* and integrated with other contents of understanding (cf. Bates (2006) and section 2.6 below). It is thus a major concern how *meaning* is conceived in the theoretical framework applied. Fillmore's frame semantics was – as already noted in the previous section – developed within the cognitive linguistic paradigm, which is associated with a *conceptualistic* approach to meaning. In this section I will demonstrate how the conceptualistic approach relates to other theories of the representation of meaning – before I have a closer look at central perspectives in cognitive linguistic theory in general (cf. section 2.3.3).

One key to the integration of cognitive linguistics into information searching theory on the topic of user revealment, is the distinction between different approaches to the study of *meaning*. Taylor (2002:186-187) presents three general approaches:

> 1) The language-world approach. Meaning is studied as the relationship between linguistic expressions and states of affairs in the world.
> 2) The language-internal approach. Meaning is studied in terms of relations between expressions within a language.
> 3) The conceptualistic approach. The meaning of an expression is equated with a conceptualization in the mind of a language user.

The first approach is associated with truth semantics, in which one considers the relationship between *linguistic expressions* and states of affairs in *the world*, in asking 'for which situations in the world is this expression true' – or the other way around. However, language-world relationships are not to be equated with meaning. "The meaning, I would claim, is to be identified with the conceptualization symbolized by the expression" (Taylor 2002:190). This is why the second and third approaches are of particular importance to us in the context of this thesis, because they are both based on a view of language as a *mental phenomenon*. We will first consider the *conceptualistic approach* (cf. point 3 above), followed by the *language-internal approach* (point 2 above).

According to the *conceptualistic approach*, meaning construction is primarily conceptual rather than linguistic in nature – this is called the conceptual nature of linguistic meaning potential. When meaning potential is characterized as conceptual, the focus is on "the open-ended character of meanings: one cannot exhaustively characterize the meanings of linguistic expressions by short, dictionary-type definitions" (Langacker 1987:489). This is because meaning is *usage-based*. Words are interpreted in relation to conceptual knowledge, which is derived from individual experiences of all kinds, acquired through our senses (vision, smell, touch, etc.):

> [A] word's meaning can be understood only with reference to a structured background of experience, beliefs, or practices, constituting a kind of conceptual prerequisite for understanding the meaning. Speakers can be said to know the meaning of the word only by first understanding the background frames that motivate the concept that the word encodes. Within such an approach, words or word senses are not related to each other directly, word to word, but only by way of their links to common background frames

> and indications of the manner in which their meanings highlight particular elements of such frames. (Fillmore & Atkins 1992:76)

The usage-based thesis concerns the relationship between language use and linguistic meaning, structures and rules. Meaning is a property of utterances (Evans 2006), i.e. meaning emerges in the context of usage events. Taylor (2002) calls this the context-dependent conceptualization of word meanings – the activation of meaning potential is dependent on the context of use. Lexical representations, e.g., words or sentences, are mental abstractions. Conceptualization takes place internally, in the mind. According to a conceptualistic semantics, we say that meanings are identified with conceptualizations. Frame knowledge (comprising linguistic expressions as well as knowledge about the world) contains only a meaning potential, because meaning is situated in language use, i.e. in actual usage events. We may say that a conceptual content plus a construal of a usage event in a given context, results in the meaning of an expression.

The *language-internal approach* to meaning potential (cf. point 2 in the Taylor (2002) citation above) is associated with Chomsky (1965) and the generative paradigm within linguistics. This is often referred to as the *dictionary view* and the *generative lexicon*, based on a structuralistic view of the mental lexicon . The language-internal approach dates back to Saussure (2005 [1916]) and other prominent advocates of structuralism, e.g., Zellig Harris and Leonard Bloomfield. Saussure describes both mental and social aspects of language (with a dichotomy between semantics and pragmatics), whereas Chomsky focuses on language as a mental phenomenon. Aitchison (2011) provides an accessible presentation of Chomsky's (1965) basic ideas.

According to the dictionary view, a word is defined by 'necessary and sufficient conditions' to separate it from other words. It is also structurally defined as its semantic relationships to other words. For instance, the word *atlases* is a hyponym to *reference materials*, whereas *bibliographic records* is a meronym to *library catalogues*, and *intellectual freedom* is an antonym to *censorship*. Each word is defined by the distance to other words in the semantic structure. Fillmore & Atkins (1992) state that common lexical semantics is based on a structuralistic view of the lexicon, in an environment with a clear distinction between mental lexicon and encyclopedy. Cruse (1986) states that a major activity for lexical semanticists is that of cataloguing the kind of inter-item relationships that can be defined for the elements of a lexicon, and characterizing the kinds of lexical sets that are structured with respect to such relationships.

Two distinctions are traditionally made in language-internal approaches to meaning potential; the distinction between *form and content of the linguistic sign*, and the distinction between *lexicon and encyclopedy*. The first notion refers to the fundamental structuralistic distinction between the *linguistic expression* (the signifier, French *signifiant*) and the *conceptual content* (the signified, French *signifié*) of the linguistic sign (Saussure 2005 [1916]). There are several other pairs of words found in the literature to refer to the form-content distinction, e.g., *phonological* versus *semantic* content, *linguistic expression* versus *concept*, or (as in thesaurus construction) *term* versus *concept*.

The second notion refers to the distinction between a separate mental *lexicon* (made up by words with their linguistic meanings), and an *encyclopedy* (containing our knowledge about the world). In a language-internal approach, linguistic signs (expressions and concepts) are contained in the lexicon as linguistic knowledge. This is separated from encyclopedic knowledge which rests in the encyclopedy. Thesaurus theory is based upon this structuralistic understanding of the mental lexicon, with a distinction between *terms* (thesaurus terms, i.e. linguistic expressions) representing *concepts* (the meaning of the terms).

In a language-internal approach, one concept can be expressed by several terms. This is called *synonymy* (traditionally explained as ‘one concept – several expressions’). According to a cognitive linguistic approach, however, there are no true synonyms. Differences in linguistic expressions are considered as being motivated by differences in conceptual content. Two terms will in this understanding always represent (at least slightly) different concepts. This makes it possible to use *word* to refer to the form-content unit, as there will never be two different words referring to the same conceptual content.

The opposite situation, however – that of several related concepts represented by one expression – is the rule rather than the exception. This phenomenon – called *polysemy* – pervades human language, and it is the object of much study in cognitive semantics. Words carry a vast meaning potential (i.e. one expression can represent several *related* meanings), and the meaning in each instance of use is defined by the usage context. (Homonymy – ‘one expression with several *distinct* meanings’ – is also resolved by interpretation in the context of use). A common example used to illustrate polysemy (cf., e.g., Lakoff 1987), is that of *bachelor*, which in a language-internal approach could be defined by the features ‘human’, ‘male’, ‘adult’, and ‘unmarried’. However, it would be odd to speak of the Pope as a bachelor, even though the word clearly instantiates each of the four defining features of bachelorhood. Neither would we consider an unmarried man, co-habiting with a woman and having children, as a typical bachelor. We could go on like this and show that actually, every word is considered to have several potential meanings.

In thesaurus construction (which we have noted is based on a traditional language-internal approach), the situation with one word representing several meanings is dealt with as homographs and homonyms. “Homographs are words having the same spelling as another but differing in origin and meaning” (Aitchinson, Gilchrist, & Bawden 2000:32). It is important to remove ambiguity in thesauri, and terminology within a topical area is considered to be more precise than colloquial language use. In thesauri construction one aims at ‘one expression – one concept’. With a conceptualistic understanding of linguistic meaning potential, polysemy cannot be disregarded in any kinds of words, whether colloquial vocabulary or terminology within a topical area.

In a thesaurus, each thesaurus term is defined by its formal relationships to other terms, expressed by the two hierarchical relationships broader term (BT) and narrower term (NT), as well as related terms (RT) and equivalence (USE/Used for). In thesaurus theory there is a clear distinction between these structural/formal/hierarchical relationships on the term level, versus the semantic/logical/conceptual relationships between concepts (Aitchinson, Gilchrist, & Bawden 2000). Thus, the hierarchical relationships BT and NT might express generic (‘type of’ – insects/flies), partitive (‘part of’ – body/torso), instance (seas – North Sea), and attributive (crime/crime for profit) relationships. Related terms express associative relationships of all kinds. The formal relationship equivalence does not express a semantic relationship, but a relationship between the formal/terminological level and the conceptual/semantic level, in handling synonyms (‘one concept – several expressions’, e.g., *domiciliary care*/*home care*). Kekäläinen’s (1999) distinction between three levels of abstraction – conceptual, linguistic, and string level – is based on the thesaurus theoretical distinction between logical relationships (on the conceptual level) and formal relationships (on the linguistic level). In addition, she adds a string level to handle variations in linguistic expressions (e.g., a term with or without compound words split into component words, and with or without stemming).

I do not disregard the need in thesaurus construction and use to maintain a distinction between terms and concepts – i.e. between the level of expression and the level of conceptual content. Terms are organized into hierarchies mirroring the semantic relationships between concepts. This distinction is necessary in thesauri because several conceptual/logical relationships (generic, partitive, and instance) can be collapsed into one hierarchical relationship (broader term/narrower term). It is also necessary for the handling of synonyms according to a language-internal approach. In discussing thesauri in this thesis, I will maintain the distinction between terms versus concepts, and formal versus conceptual relationships. In the present project, however, I focus on other relationships than those which are formally represented as hierarchies in thesauri (generic, instance, etc.). Motivated by the conceptualistic approach to meaning as presented above, I will focus on unique associative relationships between words, and the understanding that words are interpreted relative to conceptual knowledge, and given explicit meaning in the contexts of use.

The difference between the language-internal approach as opposed to the conceptualistic approach to meaning, can be contrasted in the understanding of word meanings and semantic relationships between words. In the *language-internal* approach, there is a focus on words and their semantic content, all stored in the mental lexicon. Relationships are described as invariables. In the *conceptualistic* approach, on the other hand, both words *and* relationships have a meaning potential. All words and all relationships are *unique* (cf. sections 1.2.2 and 1.3.5). Linguistic knowledge is an inseparable part of our knowledge of the world. Accordingly, there is no distinction between a mental lexicon and an encyclopedy – so we say that there is a continuum from word knowledge (lexical) and world knowledge (encyclopedic). It is worth noting that many phenomena in cognitive linguistic theory evolve along a continuum (Langacker 2007). Linguistic categories often have fuzzy borders, so there is no structuralistic understanding of units according to classical categorization principles, defined by their distance from other units. The continuum perspective applies to the interface between lexicon and encyclopedy, but also e.g., in the definition of words.

When linguistic theory is used for information searching purposes, it is often based on a language-internal approach to meaning. This is naturally so because computational linguistics is easier done with delimited units (words) and a set of invariable semantic relationships. Blair (1990) takes up a different position when he, in Ingwersen's mentioning:

> [...] rejects what is called 'mentalistic' (semiotic) theory, as well as more behavioural semiotic theory building, which maintain an unavoidable dichotomy between expressions and contents. Instead of asking "what does an expression mean/signify?", he points to the question: "how is an expression used?"[14]. In other words, Blair suggests avoiding abstract or objectively defined meanings of expressions. Instead he points to the *pragmatic* position of making use of and investigating the *actual usage of language* in relation to *activities*. (Ingwersen 1992:195, emphases original)

So Blair disregards the language-internal approach and takes a pragmatic view, focusing on language use in context. This is compatible with a cognitive linguistic approach acknowledging a continuum from semantics to pragmatics (Langacker 2008).

[14] Here Ingwersen (1992) cites from Blair (1990:136).

2.3.3 Central perspectives in cognitive linguistic theory

During the past thirty-forty years, *cognitive linguistics* has grown to become a renowned paradigm on the linguistic scene. The linguistic field can be divided into two traditions; the *functionalist* and the *formalist* tradition, respectively. In the functionalist tradition we find *cognitive linguistics* (associated with Ronald Langacker) and *functional grammar* (M.A.K. Halliday). In the formalist tradition we find *generative linguistics* (Noam Chomsky), plus the *structuralistic* tradition (Ferdinand de Saussure).

Cognitive linguistic theory deals with the mental structure and representation of words and the relationships between words and conceptual knowledge, as well as natural language use in all kinds of contexts. The linguistic ability is considered as an integral part of cognitive abilities – i.e. any kind of knowledge is simply stored in the mind, without reference to a linguistic module of some sort (like the generative lexicon in the language-internal approach). (Note that I say 'in the mind', not 'in the brain', though of course there are neurolinguistic activity going on which can be traced. The mind/brain distinction will be discussed briefly in section 2.5.1 in connection with the use of cognitive psychology in the present study). Accordingly, cognitive linguistics has an emphasis on *semantics* in the linguistic analysis (Geeraerts & Cuyckens 2007) – as opposed to, e.g., the focus on *syntax* in generative linguistics. This follows from the cognitive perspective, implying a major concern with categorization of experiences.

Let us look at an example of how the meaning of a word is defined on the basis of the conceptual knowledge associated with it. *Atlases* are, according to our shared knowledge, defined according to their content, geographical information given as maps and indexes. Concerning atlases as physical objects, we know about their shape that they are typically made of paper and take the form of a codex, often in a large format, but that they can also be found in various electronic formats, e.g., as an Internet database. These are just examples of our conceptual knowledge about atlases. A conceptual definition of the potential meaning of *atlases* represents a completely different approach to the understanding of meaning than a traditional way, applying semantic feature analysis (defining units according to 'necessary and sufficient conditions') and relating it structurally (e.g., by relating *atlases* to the hypernym *reference materials*).

Cognitive linguistics represents a *bottom-up* approach to semantics, i.e. linguistic expressions are constituted as units via abstractions of actual usage events. One central topic of research deals with form-meaning constructions. Another central topic is natural language categorization – most obviously, how words are used as names for categories. To know the word *animal* means being able to apply this word to anything that can be categorized as an animal. Other matters dealt with in cognitive linguistic research, are the pragmatic background of language in use, and the relationship between language and thought. Common to all these topics, are the focus on meaning and meaning construction, rather than isolated formal linguistic structures. Formal aspects (like constructions) are always discussed together with meaning.

Cognitive linguistics is not a single theory of language, but rather a cluster of theories originating from authors who have compatible approaches and share some basic tenets on the understanding of natural language. Ronald Langacker (1987, 1991, 2007, 2008), George Lakoff (1987), and Leonard Talmy (2000a, 2000b) are considered to be the originators of the cognitive linguistic enterprise. Most importantly, language is seen as *embedded* in the overall human cognitive abilities. Cognitive linguistics and cognitive psychology are both concerned with *cognition*: These theoretical frameworks both assume that humans in their interaction with the world mediate their experiences through informational structures in the mind. Langacker (2007) points out that the human capacity for language is not a separate module, but resides mentally as a part of general cognitive phenomena like, e.g., attention, perception, categorization, and memory.

It may seem as a matter of course that cognitive linguistics sees the human capacity for language as an integral part of the general cognitive capacities of man. Actually, it is not. This view is opposed to the generative linguistic paradigm which states that our ability to understand linguistic utterances is founded in a set of cognitive abilities specialized for linguistic processing. The cognitive linguistic enterprise originated in the late seventies and early eighties as a reaction to generative linguistics, which had been the dominating linguistic theory since Noam Chomsky published his *Syntactic structures* (Chomsky 1957).

Many introductory works on cognitive linguistics dwell on the differences between the generative and the cognitive linguistic enterprise. Such a layout is beyond the scope of this thesis, apart from the layout of the language-internal versus the conceptualistic approach to meaning which was provided in section 2.3.2. The generative and the cognitive linguistic approaches are however not different in every respect. Both these linguistic approaches study language as a *mental* phenomenon – as opposed to a view of language as a *social* phenomenon like, e.g., in James Paul Gee’s (2011) discourse analysis and social linguistics. Also, both the generative and the cognitive approach to the understanding of the mental lexicon originate in the fundamental structuralistic distinction between the form and content of the linguistic sign. In accord with a mental view on the linguistic capacity, the question of a referent ('in the world') lies beyond the linguist's purview.

When we say that cognitive linguistic theory approaches language as a mental phenomenon, this implies that there is a cognitive perspective on the linguistic explanation of acquisition, organization, and activation of linguistic knowledge. This mental focus does not however imply a denial of biological aspects dealt with in neuropsychology. These matters are just outside the scope of the linguistic explanation. Social aspects (like communicative and pragmatic functions) are explained within the cognitive perspective. Thus, both the linguistic system and language in use are studied as mental phenomena within cognitive linguistic theory.

Langacker (2007) claims that the two basic functions of language are the *symbolic* and the *communicative* functions. The symbolic function deals with how linguistic expressions make it possible to represent conceptualizations, which is a prerequisite for the communicative function, namely the communication of conceptualizations. When we experience the surrounding world, the symbolic function of language makes it possible for us to store new knowledge – e.g., when we learn how to speak our mother tongue, and when we are students and acquire new terminology. Language is thus an instrument for organizing, processing and conveying information. When language is used as a way of organizing knowledge, it does not mirror an objective reality. There is no direct link between a word and a referent 'in the world'. What we perceive as reality is always a conceptually mediated reality. Linguistic categories reveal individual and cultural needs, interest and experiences. A given language is coloured by how the world is understood by individuals within a cultural context. Linguistic expressions thus reveal cultural-specific and language-specific perspectives on conceptual knowledge. When students take a course in pedagogy and are novices in this topical area, they have to acquire an understanding of central concepts like *learning, teaching*, *motivation*, *self-efficacy*, etc. The experts in the topical area (the teachers) have much more area-specific knowledge associated with these concepts – however, not identical from one expert to another. For students and teachers to be able to communicate on a topic, they have to establish enough shared knowledge for them to understand each other. Communication is thus a way of displaying and comparing different sets of knowledge and understanding of the surrounding world.

Words are points of access to individual conceptual knowledge. Sensory-perceptual experience (i.e. perceptual data originating from interaction with the external world), as well as introspective experience, is subjective in nature. Since each individual person experiences the surrounding world each in their own way, only *parts* of the mentally stored knowledge is shared. This *conventional* knowledge about form and meaning pairings is what makes communication within a language community possible. We have already noted that many cognitive phenomena operate along a *continuum* – and conventionality represents an example of that. Conventionality in a speech community is thus a matter of *degree,* in that the meaning potential of words exists on a continuum from individual to conventional. Furthermore, words do not have a static organization. *Entrenchment* is related to the effects of frequency within a usage-based model. The activation of a word when it is used in communication and interpretation of language use, reinforces and entrenches it – and repeated use leads to further entrenchment. If a word is not exploited, there is a converse effect called decay.

According to a cognitive linguistic approach, the linguistic expression of a word is not completely arbitrary, but *motivated* (as an intermediary stand between *arbitrariness* and *determinism*). Motivation relates to 'likeness' and means that the linguistic expressions of many words are influenced by the linguistic expression of related words (e.g., when numbers following each other share one morpheme, as in thir*teen*, four*teen*, etc., or when a verb and a noun have the same root, as in *work*/*work*er, or in onomatopoeia (like *moo, crash*, etc.), when the 'acoustic image' is motivated by a likeness to some natural sound). Motivation (linguistic expressions inspired by likeness) is also found in sign language, which have several iconic signs. Semantic categories emerge from the interaction of motivation and convention, and "[c]ategories of perception *motivate* categories of language, but do not determine them" (Zlatev 2007:338, emphasis original).

We have seen that linguistic meaning is usage-based. However, some potential meanings are more salient than others. The concept of *centrality* deals with the likelihood of a specific meaning potential of being activated when a word is used. This is related to *prototypicality* and how the categorization process of usage events results in categories demonstrating prototypicality. A prototype is an entity in the world ('a thing') – "the entity to which an expression is typically applied" (Taylor 2002:188). This includes usage events which are also physical instantiations in the world, not mental entities.

We have emphasized the importance of *context* in a conceptualistic approach to meaning. With this in mind, the transmission of meaning is seriously challenged in the processes of knowledge organization and information searching. When we try to represent the content of a document by some sort of index terms, these terms are decontextualized from their usage events as recorded in the document. Another decontextualization occurs when a searcher tries to represent an information need by a set of search terms, which are taken out of their conceptual knowledge context. In standard thesauri, we try to add context to the words by their hierarchical connection points (e.g., that *learning* is related to *problem based learning* and several other narrower terms). In recognition tools like PedNett, we add context by providing individual associative relationships to each word (e.g., that *learning* is related to *play, motivation, knowledge, mastery, socializing, etc.*), plus relationship descriptions providing descriptive texts with explanations and interpretations of the relationship between each pair of words. These attempts of contextualization are useful for different purposes, but neither of them can contribute meaning in the same manner as language use in a natural usage context.

2.4 Knowledge formation in information need formulation

In the previous section we described how conceptual knowledge is *represented* in the mind according to cognitive linguistic theory. We now go on to look at the *activation* of conceptual knowledge. This will be used in the understanding of the cognitive processes involved in information need formulation and terminology learning, as well as the investigation of how an associative semantic network can help students in the elaboration of information-based work tasks. The role of linguistic processing in the user revealment process is made clear when we consider that meaning is usage-based. Linguistic meaning emerges in the context of usage events, so in students' learning of new terminology, they will benefit from all kinds of language use in which concepts that are new to them occur in various contexts of use.

When students elaborate information needs as a part of their work tasks, chunks of conceptual knowledge are activated. Relevant frame knowledge is actualized and contextualized. In the subsequent knowledge formation process during information need elaboration, current frame knowledge is enriched by new structures which are integrated into the existing frame structures. Frame knowledge is changed and accumulated throughout the information need formulation process.

2.4.1 A frame semantic perspective on acquisition of terminological competence

Fillmore, in arguing for the need for frame semantics within linguistics, asks "the question of what it takes for something to be represented as a lexical item", and states that "[a] general answer to this question is that if a language has a word, there must be some category of thought, identified by an associated cognitive schema current in the speech community, which this word activates” (Fillmore 1977a:25-26). There is some knowledge which ‘anchors’ the word. For our purpose, we can equal a cognitive schema with a chunk of conceptual knowledge. A word performs a categorizing function when it refers to a chunk of conceptual knowledge. This knowledge is said to have a name when it is “linked with a frame, and that means being categorized by a schema in terms of some sort of salient cognitive distinctiveness” (Fillmore 1977a:26-27).

We have noted that frames are *individual* in each language user. When we add to our frame knowledge, it is integrated with our current knowledge, always based on our individual experiences. At the same time, when students go about studying a topical area, it is a part of the educational process to gain a basic understanding shared with teachers and other students working in the same topical area. This is like in ordinary language use. Though we have our own individual conceptual frames, we need to have some *shared* knowledge to be able to understand each other in communication.

The frame semantic view of linguistic meaning implies that a prerequisite for our understanding of a word is an understanding of the *context* in which the word is used. When students acquire new knowledge structures and a terminology specialized for a specific topical area, they get acquainted with a new ‘world’, a new culture. Each topical area has its own culture, and my student informants are in the process of entering the world of *pedagogy*. In this process they will establish coherent chunks of conceptual knowledge associated with new or enriched frames. To be able to interpret a word from the pedagogical area means thus to be able to recognize and activate the context in which it belongs, i.e. which frame(s) the word is linked to.

Students have to be in a continuous process of enlarging their frame knowledge. This involves not only learning new terminology, but to establish associations between words and all sorts of contextualized knowledge. In the beginning there is little or no overlap between the individual vocabulary of the student’s everyday language and the terminology used in documents and teaching concerning the new topical area. The terminology used for indexing in searching systems can also represent an obstacle. There are, however, differences between the terminologies in different topical areas when it comes to the nature of the words which are used.

Sometimes a new topical area comes with a completely unfamiliar terminology. In pedagogy, many of the words used are already found in everyday vocabulary, but the words are linked to more specific conceptual content when they are used in this specific topical area. Examples are words like *motivation* and *play*, for which the students have to enrich their understanding. We may think of terminology learning as the establishment of frames on all levels of complexity in the topical area of pedagogy. The words, relationships and all associated knowledge come together in a pedagogic framework. In other topical areas, like medicine and physics, there are more area-specific terminologies. Whether one has to learn specific words – or attach already known words to new meanings – the mastering of an area-specific terminology involves acquisition, structuring and labelling of new knowledge. For students of educational science, the mastering of pedagogic terminology makes them able to handle pedagogic questions and to be in a constant process of structuring new knowledge.

2.4.2 Language, thought, and students' learning of new terminology

In a cognitive linguistic perspective, language is used to categorize and express conceptualizations. The linguistic expressions reveal how matters in the world, within a culture, are conceptualized – so the direction goes from thought onto language. The relationship between language and thought (and which direction the influence goes between the two) has been an issue for debate in linguistics at least since the writings of Sapir and Whorf in the 1940s and 1950s (Pederson 2007).[15] Sapir and Whorf are ascribed the hypothesis of *linguistic relativity*, which claims that language influences thought, i.e. that "we dissect nature along lines laid down by our native languages ... by the linguistic systems in our minds".[16] Few if any linguists adhere to the strong version of this hypothesis – that our thoughts are determined by the categories available in our native tongue – that is to say, without language, there would be no thoughts.

According to my understanding of the cognitive linguistic framework, we might assume that there is a back-and-forth movement between language and thought; that is, thought influences language, and language influences thought. The categories we make are coloured by our thoughts and our understanding of the world, within a cultural context. This tenet is the basis for metaphor theory in cognitive linguistics (Grady 2007; Lakoff 1993). Also, when we acquire new words, the way the linguistic categories organize the world, influence how we think about it. Motivated signs (e.g., onomatopoeia and numbers) exemplify how linguistic expressions might influence conceptualization.

[15] Primary sources (not consulted by me), are: Sapir, E. (1949). *Selected writings in language, culture and personality*. Edited by David G. Mandelbaum. Berkeley: University of California Press. And: Whorf, B.L. (1956). *Language, thought, and reality: Selected writings*. Edited and with an introd. by John B. Carroll. Foreword by Stuart Chase. [Cambridge]: Technology Press of Massachusetts Institute of Technology.
[16] This citation of Sapir & Whorf is fetched from Crystal's 4th ed. (1997:339) of *A dictionary of linguistics and phonetics*. I have not consulted the original sources of Sapir & Whorf.

All this being said, the primary focus in this back-and-forth movement between language and thought is according to cognitive linguistics that our experiences and thoughts about the world influence how we produce linguistic categories. This is called the *experientialist* position of cognitive linguistics vis-à-vis human knowledge. This position "emphasizes the view that human reason is determined by our organic embodiment and by our individual collective experiences" (Geeraerts & Cuyckens 2007:5). It is called *embodied cognition*, and resembles Bates' (2005, 2006) concept of *embodied information* (which will be presented in section 2.6). We see that experientialism and embodiment is related. Lakoff describes conceptual *embodiment* as:

> "[t]he idea that the properties of certain categories are a consequence of the nature of human biological capacities and of the experience of functioning in a physical and social environment. It is contrasted with the idea that concepts exist independent of the bodily nature of any thinking beings and independent of their experience". Lakoff (1987:12)

Language is used to organize knowledge reflecting needs, interests, and experiences in individuals, influenced by the cultural and environmental context they live in. According to Langacker (1976), the idea of 'no thought without language' is not in accord with the cognitive linguistic approach. However, language-specific structures might influence how we conceptualize and think about matters we experience. In Norwegian, e.g., we have a word for the unit of a day and night called *døgn* '24 hours' which is not found in English, whereas in English we have *a fortnight* to refer to 14 days, a category without an expression in Norwegian. This adheres to the weak version of the Sapir-Whorf statement – that languages vary with respect to how conceptual content is expressed by linguistic categories.

The relationship between language and though is relevant to keep in mind in relation to students' learning of new terminology in a topical area. The terminology in the topical area is the result of conceptualizations and categorizations done by the experts in the field. However, topical novices are presented with the terminology before they have gained experience in the field – so they acquire a terminology before they have acquired a rich body of knowledge onto which they can apply it. This is the situation with my student informants in pedagogy.

When students are presented with pedagogic terminology, they are 'urged' to perceive of matters in a certain way. So they learn the word *skolefritidsordning* 'school – spare time – day care facility' to refer to day care facilities for schoolchildren, and with this expression the emphasis is put on the spare time aspect of this after school-programme. When this has recently been renamed to *aktivitetsskole* 'activity – school' in the Oslo school, the emphasis has been shifted to school – in line with the development towards a full-day school.[17] The two different expressions give different associations – in line with changes in how the experts perceive of the matter in question. So changing interpretations of what a category comprises leads to the need for new expressions, which again will give rise to new associations and thoughts. In cognitive linguistics, the focus of this pendulum movement is on how linguistic expressions reveal conceptualizations, a matter dealt with in metaphor theory and the study of polysemy (Lakoff 1987). This has inspired the research design of the present project, in which the teacher informants produce word associations and relationship descriptions based on their different conceptualizations of words and their relationships in the topical area of pedagogy. The motivation for presenting the variation of the teachers' understanding of this topical area (which is obvious both in the associations and in the descriptive texts), is that students might benefit from using a semantic tool (PedNett) which is based on the general principle of how our minds are structured – associatively, dynamic, and with individual variation.

2.4.3 Information needs: Connecting information searching and knowledge formation

I mentioned in section 1.2.3 that Cole (2012) elaborates a theory of information needs linking information searching and knowledge formation. His layout of how information needs work in the prefocus and focusing stages is based on a study of 45 history PhD students. Cole applies Minsky's frame theory (cf. section 2.3.1.4). He starts by defining the concept of *information need* as "the motivation people think and feel to seek information", and delimits his scope to "information search involving user interaction with an information system" (Cole 2012:3). "The information need drives the human to seek information until the human produces and explanation-cum-revised expectation set, an internal process involving information process, information flow, and knowledge generation" (Cole 2012:49). Information needs begin from stimuli received by the user from the environment. Cole is concerned with information *searching*, not with information seeking (purposive information behaviour) or information behaviour in general, cf. Wilson's (1999) nested model of the information seeking/searching research areas presented in section 1.3.1.

Cole contrasts the *computer science* versus *information science* perspectives of information needs and system feedback. Computer science envisions a human-computer interaction with a corrective or negative feedback-based system, in which the user is corrected

[17] *Skolefritidsordning* and *aktivitetsskole* have the same translation ('day care facilities for schoolchildren') in the dictionary *Norsk-engelsk ordbok for grunnopplæringen* (Utdanningsdirektoratet 2011).

if s/he makes an error in the formulation of an information need. In this vision an information need is considered static. The information science perspective, on the other hand, "envisions a shifting or evolving investigation of information if the user is conducting the information search during an exploratory phase of performing a task or solving a problem. The type of feedback in the information science case is a positive feedback-based adaptive system" (Cole 2012:45). Cole devotes his attention to the information science perspective in describing the user's challenges in the search situation like this:

> The user from this perspective doesn't know the answer he/she is searching for and therefore finds it difficult to formulate a query to the system. The query, as a formulation of the user's information need, must in a certain sense open the door to information flow, which is controlled by, in general terms, what the user already knows, thinks, and believes, and the neurological architecture of the reasoning part of the brain. (Cole 2012:4)

The information need in information science is like a door opener to the user's perceptual and information system. In the computer science perspective, on the other hand, "the user's information need is to find an answer, the form of which is known by the user beforehand" (Cole 2012:3) – so the query to the information system resembles a *demand* to obtain a specific form of answer. In the information science perspective, on the other hand, a demand is at the outer end of a continuum from information *need*, information *use*, and information *demand*, based on the users' degree of knowledge about what information they need.

In Cole's theory, information searching occurs in three stages of any information-based work task, i.e. the *prefocus* stage, the *focusing* stage, and the *post-focus* stage. The user has a different understanding of her/his information need in each of the three stages. Cole relates these stages to Kuhlthau's (2004) stages 3-5, i.e. the prefocus exploration, focus formulation, and information collection. In the prefocus stage in Cole's theory, the user is engaged in 'unknown item search' and "investigates a shifting series of aspects of the broad topic of the search. There is a problem of information overload in the results list" (Cole 2012:95). This is as opposed to 'known item searching' which primarily takes place in the post-focus stage. Cole states a continuum from *unknown* to *known item search* developing along the prefocus, focusing and post-focus stages. The cognitive processes involved in the users vary a lot along this continuum. Cole relates the unknown-known-continuum to *aspect matching* (unknown item search), *best match* (intermediate), and *perfect match* (known item) kinds of searching. The conception of information needs in information science primarily relates to the 'unknown item search', as opposed to the conception of information needs in computer science which is related to the 'known item search'. In real-life situations the users will find themselves at different stages along this continuum during their work task process.

In prefocus searching the users explore the information system using ill-defined questions. At the outer 'unknown' end of the item search continuum "users only know fringes of a gap in [their] knowledge,[18] making it extremely difficult for them to identify and describe the information gap or need. Because these users do not have knowledge of their information need when the search commences[19], they cannot identify an effective start state from which to form a query and utilize the catalog effectively" (Cole 2012:103-104). Exploratory users are not able to form strong relevance criteria in the prefocus stage. The users find their "attention wandering from the original aspects being investigated, from which the original query to the system was formed" (Cole 2012:107), and find themselves wanting to investigate other aspects which come into their minds due to input from the search results.

We have seen that Cole via information science, computer science, and Minsky's frame theory presents a theory of knowledge formation in the prefocus stage of information-based work tasks, which is highly compatible with the framework I have arrived at in approaching information searching with a cognitive linguistic perspective. I have also announced that I would like to integrate a cognitive psychological perspective in my layout of the information need formulation process. This will be the topic of the next section.

2.5 Psychological factors involved in information need formulation

When students elaborate their information needs in the prefocus stage, several psychological processes are triggered. I find it necessary to present, as a part of the theoretical framework, an account of the psychological mechanisms I have assumed in the research design. I have already presented the processes of representation and activation of conceptual knowledge, using cognitive linguistic theory (cf. sections 2.3-2.4). This section provides a presentation of some additional mechanisms which are described in cognitive psychology. The understanding of psychological mechanisms according to cognitive linguistic and psychological theory has motivated the research design of the present project. However, a full account of all the psychological mechanisms which are on the scene in connection with information searching – specifically during the prefocus information need formulation stage – would be outside the scope of this project. The layout of psychological mechanisms which come into play in the

[18] Cole refers to Bates (1998:1186).
[19] Cole refers to Belkin, Oddy & Brooks 1982a and Borgman (2000), of which the latter is not consulted by me and therefore not included in the reference list at the end of this thesis: Borgman, C.L. (2000). *From Gutenberg to the global information infrastructure.* Cambridge, MA: The MIT Press.

process of information need formulation is primarily based on Anderson (2000), Eysenck (2001), and Reisberg (2001).

In the following sub-sections, I will first make some reflections on the relationship between cognitive psychological theory and the cognitive linguistic enterprise (cf. section 2.5.1). This is only a short introduction, as the methodological considerations on how psychological processes are triggered by PedNett use are placed in section 3.3 concerning the Prearrangement study. In section 2.5.2, I will go on to explore the mechanisms of *recognition* and *recall* (in the psychological sense of the word, as *recall from memory*), and discuss why recognition is superior to recall in the retrieval of memories. This is relevant for the situation in which users have to come up with search term candidates. Following the section on recognition versus recall, I will present how the units in the mental lexicon is related and activated according to the spreading activation theory (section 2.5.3). In section 2.5.4 I will discuss some causes of recall problems. All the issues presented in this chapter will be related to the empirical study, concerning how users formulate their information needs. The challenges faced by the users in the selection of tentative search terms, will be discussed in light of the psychological factors involved.

2.5.1 On the use of cognitive psychology in the present study

There is always a possibility in interdisciplinary studies that one removes a theory out of its framework and the intended context of use, and employs it within a different perspective in one's own research. Basic assumptions might be overlooked, or there might be discrepancies between the general frameworks of the theories involved. However, cognitive psychology and cognitive linguistics are not too far apart. As I mentioned in section 2.3.3, cognitive linguistics and cognitive psychology are both concerned with *cognition.* Both these theoretical frameworks assume that humans mediate their experiences through informational structures in the mind during their interaction with the world.

In reading the psychological texts, I have contemplated on a couple of differences between cognitive psychology and cognitive linguistics. In cognitive psychology, one aims at making experiments in which one single phenomenon is tested, trying to control the effects of all other phenomena by keeping them constant. In cognitive linguistics, the aim is to describe and explain linguistic phenomena in all their complexity. It is a bottom-up approach aiming at using empirical data from natural language use. There are, however, examples of laboratory research done by cognitive linguists. Typically, they work in cognitive science departments and publish their research both in linguistic and in psychological channels. One example is Seana Coulson, who is engaged in cognitive linguistics, psycholinguistics, cognitive neuroscience, and neuropsychology – cf. Coulson (2001).

Another distinction is that in cognitive psychology (especially the field which is overlapping with cognitive neuroscience); the aim is to describe processes in the *brain*, whereas in cognitive linguistics, it is referred to linguistic structures in the *mind* – so there is a difference in scope of each approach.[20] Though linguistic processing from a biological perspective deals with neurophysiological processes, the realm of cognitive linguistics is not primarily neurons in the brain, but how the linguistic capacity of the mind can be described, paralleling a classic 'body and soul' distinction. Admittedly, though, some linguists touches upon activation patterns in the brain and other brain functions – see e.g., Coulson (2001) and Fauconnier & Turner (2002) who discuss activation patterns in the brain. Bybee (2001), without explicitly mentioning the brain, is strongly inspired by connectionist modelling when she speak about storage of words as networks of connections. Also, there is an increased interest in interdisciplinary research in cognitive linguistics and cognitive psychology. This just shows that there is not – and need not be – a sharp distinction between linguistics, psychology and neurophysiology – only different approaches to the explanation of cognitive processes.

Based on the considerations of the differences as well as connection points between cognitive psychology and cognitive linguistics mentioned above, the psychological mechanisms described in this chapter can be applied in the realm of information searching. Cognitive psychology and cognitive linguistics share the *connectionist* perspective on neural networks, disregarding a 'brain as computer' metaphor. This is in accord with my approach, focusing on cognitive aspects in the human end of the human-computer interaction in information searching. The computational modelling technique called connectionist networks is "based on an analogy to neurons, which uses elementary units or nodes that are connected together; each network has various structures or layers (e.g., input; intermediate or hidden; output); also called neural networks" (Eysenck & Keane 2000:529). "Language does not resemble a collection of computer programs. Rather, it inheres in the dynamic processing of *real* neural networks" (Langacker 2008:10, emphasis original). Unlike most computational models, the connectionist models engage in parallel processing. Eysenck (2001:7) sees this as

[20] Mind: "the part of a person that thinks, reasons, feels, and remembers". Brain: "the organ of the body in the head that controls functions, movements, sensations, and thoughts" (Merruan-Webster at http://www.merriam-webster.com/).

an advantage, "because most human information processing occurs in a parallel rather than serial fashion".

In the rest of section 2.5 I will present some psychological mechanisms which are generally on the scene in connection with prefocus information need formulation. An understanding of these mechanisms will contribute in our understanding of cognitive aspects of this topic. The empirical study is based on an assumption that students can benefit from an activation of their current knowledge (Bybee 2010; Jackendoff 2002), and the research design aims at triggering the psychological mechanisms described below. Of special importance is the mechanism of recognition, which is presented in the next sub-section. In chapter 3 on method and the empirical study, I will more specifically present my considerations on the psychological processes triggered by PedNett use in the present study (cf. section 3.3).

2.5.2 Retrieval of memory in information searching: Recognition versus recall

Recall in psychology deals with the retrieval of stored memories. Recognition occurs if a person is confronted with some kind of stimulus matching the memory content. According to psychological research, it is easier to *recognize* some information which is needed in a situation rather than to *recall* the same information from memory. This is described in Anderson (2000:274) as a general observation, and called "the common wisdom that recognition is easier than recall". *Recall* is here used in the sense fetched from the topical area of psychology, not in the sense found in information retrieval (as recall versus precision during searching). Because recognition "provides more retrieval cues" (Anderson 2000:268), it is easier to recognize something that has been encountered before than to recall it. A cue is "[a]n element that is associated to a memory and that can help retrieve it" (Anderson 2000:417). This valuable aspect of human cognition is explained by the fact that recognition involves less processing than recall. In recall, there is first a search and retrieval process generating word alternatives, followed by a decision or recognition process. Recognition, on the other hand, involves only the last of these two stages (Eysenck & Keane 2000). In recognition, there is a matching process between some content from an external stimulus, and content stored in memory. Inadequate retrieval cues will cause cue-dependent forgetting "in which the information is stored in memory but cannot be retrieved" (Eysenck & Keane 2000:530).

Cueing is also dealt with in a cognitive linguistic framework by Taylor (2002:443), in a layout of "context-dependent conceptualization of word meanings" (called semantic flexibility). The implication of his description is that recognition of a word interpreted in a given context, will simplify the retrieval of related words within the same topic. Cue words pertaining to a highlighted area will be more effective than words pertaining to a non-highlighted area. We may conclude that recognition is easier than recall in the retrieval of memory, and that recognition of a given word facilitates the recall of other words from the same, highlighted area. These are mechanisms which are utilized in PedNett, as will be dealt with in chapter 3 on method.

The benefits of recognition and its effect as cueing for further recall, is especially useful for topical novices, as it helps them to "access the appropriate domain-based knowledge" (Taylor 2002:451). Topical experts will have a more entrenched vocabulary (because of frequency of use of the words), and they will therefore be better able to recall words without cueing. This expectation is confirmed by Markey (2007) who states that subject searching is typical for novices, whereas topical experts typically perform author name searches as well as other information seeking activities like getting suggestions from colleagues and being notified of relevant literature during their general surveillance of a topical area. Semantic tools for recognition in the prefocus stage are therefore primarily aimed at topical novices.

A person without any knowledge in a topical area will have no access point to activate a recognition effect. Prior knowledge has a crucial role in cognitive processing, including linguistic processing. In presenting the Pathways to Knowledge model in section 2.2.3, we saw that the prefocus stage enables searchers to make a connection between their topic and prior knowledge. When users find themselves in a situation where they have to handle complex information needs without sufficient prior knowledge, information need formulation is hampered. This will be discussed in association with *the label effect* in section 2.5.4.2.

The superiority of recognition over recall in retrieving memories is highly relevant in the information search situation, but has not always been supported in information system design: "Most of us can identify good terms from a list of related ones far faster and in greater numbers than we can think up such terms on our own. On the whole, the design of information retrieval systems has seriously underutilized this powerful feature of human psychology" (Bates 1990:27). Eight years later Bates again states that system design should support the phenomenon that people can recognize information they need much more easily than they can recall it:

> The average person will recall (think up) only a fraction of the range of terms that are used to present a concept or name, but can take in a screen full of variants in an instant, and make a quick decision about desired terms for a given search. Most current information systems require that the searcher generate and input everything wanted. People could manage more powerful searches quickly if an initial submitted

> term or topic yielded a screen full of term possibilities, related subjects, or classifications for them to see and choose from. (Bates 1998:1202)

Since these statements, online searching thesauri and other recognition tools have become a more common phenomenon in retrieval systems. In fact, recognition has become the common principle in most computer based tasks. Whereas early computer programs required commands to be recalled and used without any help from the system, we now can select from menu lists and icons. Several studies in information searching are made on thesaurus-enhanced search environments in which information searchers are interacting with a searching thesaurus in query expansion – cf., e.g., Jones et al. (1995), Lykke Nielsen (2002), Shiri & Revie (2006), and Sihvonen & Vakkari (2004a & 2004b). These studies confirm that thesaurus navigation reveal to the searchers new words which they have not thought of by themselves, but which they recognize as useful and relevant when they are presented in the thesaurus. Bates' (1986) thoughts on an end-user thesaurus containing a large lead-in vocabulary were presented in section 1.2.3.

Sara Knapp (2000) has published an unusual variant of a searching thesaurus, called *The Contemporary thesaurus of search terms and synonyms: A guide for natural language computer searching*. Unlike other searching thesauri, the Knapp thesaurus is not organized in thesaurus relationships. Each entry consists of terms and phrases that are synonyms, near-synonyms or associatively related terms – all in one alphabetical list. This list also contains words that are obviously not synonyms in ordinary usage, but can be used in component expressions covering the same topic. The example given in the users' instruction (p. xiii) states that to search for information about *homeless children*, it is useful to be reminded of both *the effects of homelessness on children*, and *childhood experiences of homelessness*. Different spellings and morphological endings are also provided. Suggestions for Boolean combinations are provided in the 'choose from' and 'consider also' notes. Unlike traditional thesauri covering one topical area, the Knapp thesaurus has an interdisciplinary perspective, covering business, the humanities, and social sciences. The general idea behind the Knapp thesaurus is to take advantage of the superiority of recognition over recall in the retrieval of memory, for the searchers to arrive at adequate search term alternatives. The same idea has inspired my research design in the establishment and use of the semantic network PedNett, developed and used for the purpose of the data collection in the present project.

2.5.3 Related units in the mental lexicon: The spreading activation theory

When a unit in the mental lexicon is retrieved, semantically related units are activated through *spreading activation*. Reisberg defines spreading activation as "[a] process through which activation travels from one *node* to another, via associative links. As each node becomes activated, it serves as a source for further activation, spreading onward through the network" (Reisberg 2001:A12, italics original).

The spreading activation theory is a feature of neural network models which are proposed within the framework of psychology and psycholinguistics (Aitchison 2012), and it has been tested in association and priming experiments. Spreading activation can also be applied in information retrieval, modelling a network of nodes representing documents and words contained in those documents. Cf., e.g., Crestani (1997) for a survey of the use of spreading activation techniques on semantic networks in associative information retrieval. It assumes parallel processing in the network: "[A]ctivation spreads out from its starting point in all directions simultaneously, flowing through whatever connections are in place" (Reisberg 2001:237). In a given speech act, many more words than those which are actually uttered are activated in the process of lexical retrieval. This effect is relevant in contemplating the information need formulation process.

Spreading activation is a model in which psychology and linguistics describe the same phenomena, but at different levels. When spreading activation is described in psychology, it refers to characteristics of nodes and relationships in neural networks in the brain. When spreading activation is described in cognitive linguistics, reference is made to words in the mind – and the setting is natural language production. In this chapter, *units* and *nodes* are both used to express the same phenomenon. In cognitive psychological literature *nodes* is commonly used with reference to nodes in neural networks, whereas *units* is used in cognitive linguistics when discussing units in the mental lexicon.

The relevance of spreading activation in information searching is obvious. When a word is first used to express an information need, this word will in turn activate a network of related words, which might also be relevant to consider as search terms. So as soon as one is able to express a topical facet of a search task, it will be easier to come up with additional words related to each facet. In the following section I discuss the relevance of the spreading activation phenomenon in connection with terminological competence, knowledge of a topical area, and the formulation of information needs.

2.5.3.1 Spreading activation and connectionism applied in linguistics

The spreading activation theory is commonly used in *connectionist models* used by cognitive psychologists. Connectionism is “the school of thought that propounds the use of connectionist networks or neural networks as computational models of the mind” (Eysenck & Keane 2000:529). The basic assumption for connectionist models is that psychological processes can be described by interconnected networks of units. Connectionist networks “consist of elementary units or nodes that are connected together; each network has various structures or layers (e.g., input, intermediate or hidden, output)” (Eysenck 2001:382).

The cognitive linguist Langacker (1991) sees the neural network model of connectionism as an alternative style of computation to a standard digital computer model. The latter is based on digital operation, serial processing according to programs, rules and representations, and local memory (each memory stored at a particular address). Langacker rejects “the metaphor that likens mind to a digital computer and language to a program that it runs. CG[21] is more at home in the “connectionist” (“neural network”) world of dynamic systems, parallel processing, distributed representations, and computation by simultaneous constraint satisfaction” (Langacker 2008:10, quotation marks original). Each node in the network has a certain level of activation and may ‘fire’ when its value reaches a certain threshold. There is parallel processing over distributed (rather than local) memory representations. Langacker points out promising aspects of the connectionist model, though he does not adhere completely to it. He suggests an approach “that is basically compatible with a “connectionist” or “interactive-activation” model of cognitive processing” (Langacker 1990:282, quotation marks original), pointing out how the model would have to be developed further to accommodate to language processing in all its complexity.

Spreading activation is also assumed by Langacker as a principle in language processing: “The primary activation of one node in a usage event can thus induce the secondary activation of an indefinite and variable array of other nodes connected to it through categorizing relationships, either directly or indirectly” (Langacker 1987:385). Other cognitive linguists also refer to the effects of spreading activation: During lexical retrieval, “whole networks of concepts that can be related to a target word in various ways (e.g., synonyms, antonyms, superordinates, subordinates, collocates, elements of one frame) achieve some level of activation” (Schmid 2007:122). The activated node is selected during speech production from these networks of various connections. Spreading activation is a

[21] Cognitive grammar, i.e. the branch of cognitive linguistics which is develped by Langacker.

continuous process which will also lead to words popping up into consciousness of which one may not be consciously aware of the relatedness to the words or thoughts which have primed this interrelated memory.

2.5.3.2 Degree of fan and strength of association

There are several mechanisms working simultaneously when neural networks are activated, and opposing effects can potentially cancel each other out. One example is how the *fan effect* influences on retrieval success. The fan effect deals with the degree of associations fanning out from a node, entailing that there is “an increase in time to retrieve a memory from a cue as more memories are associated to the cue” (Anderson 2000:418). Nodes in the network differ both in degree of fan (number of associations) and in *strength of association* (activation per association). Strength of association is “[a]n attribute of memory records and their associations that determines how active they can become” (Anderson 2000:424). According to the model, the quantity of activation is limited and distributed on the number of associations out from a node. The retrieval of one single memory unit connected to a node which has many associations to other nodes, is harder than if there had been only one association (i.e. the one between the two nodes in question). Accordingly, a low degree of fan (few competing associations) gives a high degree of strength of association, which again improves the chances of retrieval success. However, a high degree of fan provides many pathways which can lead to a node. Since there is parallel processing in the network, a high degree of fan provides many potential cues. So on the one hand, retrieval success can be positively affected both by a *low* degree of fan (giving a high degree of association strength), *and* by a *high* degree of fan (providing many cues).

We have to take into account two other mechanisms affecting the retrieval of memory units, i.e. recency and frequency of use. Both these mechanisms improve the strength of association: “[T]he activation level of each node depends on how much activation that node has received and how recently the activation arrived. [...] Activation of a node will also serve to summon attention to that node; this is what it means to “find” a node within the network” (Reisberg 2001:237, quotation marks original). If we take into account the matters of recency and frequency of use, we can assume that the best bet for retrieval success is a high degree of fan combined with high frequency as well as recent use. When students acquire terminological competence in a topical area which is new to them, they establish all kinds of connections in the mental lexicon. Experts will have highly interconnected networks, and the nodes will be entrenched after frequent use over a long time span. In activating the nodes (e.g., as my expert informants did in the word association testing), they also benefit from the recency effect.

In psychological testing, the experimental setups are made to control for all other aspects than the one which is being tested. The topic studied in the present project concerning the prefocus information need formulation stage, is a complex situation in which many psychological as well as other aspects are on the scene simultaneously. These are e.g., the informants' knowledge level in the topical area of pedagogy, whether they have seen or worked on the assignment before, their usual ways of studying and working on assignments, and their information seeking habits. I needed data on a situation which is not possible to log in a real-life setting, but I wanted the experimental setup to be as close to a real-life setting as possible. Based on my empirical study, I will be able to describe the complexities seen in the data concerning the information need formulation process. However, I will not be able to (nor do I aim to) ascribe the variation in the informants' performance to the different psychological processes taking place during the task performance.

2.5.4 Causes of recall problems

We looked in section 2.5.2 at the superiority of recognition over recall in retrieving memories, specifically when users try to retrieve relevant search term candidates. Section 2.5.3 gave a brief introduction to how spreading activation works when units in the mental lexicon is retrieving, causing the activation of semantically related units. Let us now look at some causes of recall problems, which may be ascribed to characteristics of the neural networks as well as retention of memories.

2.5.4.1 Characteristics of the neural networks

In speech production, there has to be a selection mechanism reducing distraction and halts the retrieval process once a word has been selected to represent a concept. If the selection process went on and on once a node had been fired, speech would be difficult. The *winner-takes-all system* is "a process in which a stronger node inhibits weaker ones, so that the stronger node comes more and more to dominate the weaker nodes" (Reisberg 2001:A14). Once a node has been fired (a word has been recalled and retrieved from memory), the activation of related nodes is weakened. In ordinary conversation, the winner-takes-all system is a prerequisite for the speech production. If however the retrieved node is just close to what one tries to remember, but not quite right, the winner-takes-all mechanism can lead to a retrieval block. When a neighbouring node of the sought-after node is fired, causing a weakening of the activation of associated nodes, it is harder to retrieve the right node. The best bet for finding the target information may then actually be to give up the search for a while, allowing the activation of the fired node to decay, thus weakening the inhibition attached to its neighbours, in turn making it easier to activate these neighbouring nodes.

One kind of retrieval block which can be produced by the winner-takes-all system, is the *tip-of-the tongue state*, often referred to as T.O.T. "People in the T.O.T. state often know correctly that the word is somewhere in their vocabulary, they often correctly remember what letter the word begins with, how many syllables it has, and approximately what it sounds like" (Reisberg 2001:257). Sometimes this 'feeling of knowing' something one at first is unable to recall, results in successful recall during a conversation in which related nodes to the hard-recalled item is activated.

When searchers find difficulties in remembering synonyms or other alternatives to a search term, it could be explained by the winner-takes-all mechanism. Once a word has been selected to express a topical facet, the next word to come into the searcher's mind will probably *not* be a synonym or near-synonym, as the activation of neighbouring words has been weakened. Sometimes the winner-takes-all mechanism can be counterproductive in searching. Nordlie (2000) observes that searchers in their interaction with a retrieval system struggle in finding search term alternatives when a term has failed to retrieve adequate references. According to the logs, searchers might even type in the same search term again – with the same useless result. "Users need prompting to reveal the real purpose of their search" (Nordlie 2000:143). This motivates an element in the research design of the present project, in that the students are prompted (in my word *triggered*) by PedNett use to reformulate their set of tentative search terms.

Lykke Nielsen (2002) performed a word association test as a prerequisite for the making of an associative thesaurus. "The respondents were asked to find retrieval synonyms and terms closely related to the stimuli words according to the perspective and tasks of the work domain" (Lykke Nielsen 2002:116). Though the informants were specifically invited to provide both synonyms and related terms, an overwhelming majority of the response words (70 %) in Lykke Nielsen's study were – expressed by thesaurus terminology – related terms (i.e. expressing an associative relationship) in relation to the stimuli words. Synonyms made up the second largest category (approx. 23 %), with broader terms (approx. 3.7 %) and narrower terms (3.4 %) as minor categories. Vakkari, Pennanen & Serola (2003) provides an example of the same tendency with a large category of associative relationships, but in a search term selection setting. They analyse, in a longitudinal study, how students select search terms in different stages of the writing of a research proposal. In comparing their search term selection in the first and second session (the second conducted several weeks later than the first session), it turns out that the majority of the new words were related terms (i.e. associatively related) to the first selected words within each facet. The second largest category was narrower terms (generic, partitive, etc.). Very few broader terms were selected, and hardly any synonyms.

2.5.4.2 Retention and forgetting of memories

When a user is in the situation of trying to come up with relevant words to represent an information need, he or she faces the challenge of remembering memories previously stored in the neural network – linguistically speaking, words stored in the mental lexicon. We will now look at the retention of memories (how conceptual knowledge is kept/stored in memory) and causes of forgetting, which is what we face when failing to recall specific memory units.

According to cognitive psychological research, there are three basic causes of forgetting; *decay*, *retrieval-cue failure*, and *interference* (Anderson 2000, Reisberg 2001). Decay means that the memories simply weaken as a function of time and therefore are harder to retrieve. The memories may however still be intact, and the retrieval problem can be caused by lack of retrieval cues. Then we have a situation with retrieval-cue failure, which is the kind of "forgetting that asserts that people lose access to memories because they lose access to the cues that can retrieve them" (Anderson 2000:423). The memories are kept in long-term storage, but one is unable to locate them. Reisberg points out that the memory units are intact in situations of retrieval failure:

> In many circumstances, we are unable to remember some bit of information, but then, a while later, we *do* recall that information. Since the information eventually was retrieved, we know that the information was not "erased" from memory through decay or inference. Our initial failure to recall the information, therefore, must be counted as an example of retrieval failure. (Reisberg 2001:204, emphases original)

Of particular interest for us, is the third cause of forgetting, called interference. Interference is a phenomenon involved both in the learning of something new (input interference) and in retrieval of memories (output interference). The learning of something new can cause forgetting of something previously learned, because "[t]here is a great deal of interference when we try to maintain multiple associates to the same items" (Anderson 2000:243). The interference effect also comes into play in the retrieval of memories, a situation which is relevant for the information need formulation process, when users activate their memory to come up with search term candidates. *Output interference* refers to the situation when the recall of selected memory units interferes with the retrieval of those memory units which selected memory units was stored together with. There is a negative relationship between two sets of memories. Interference involves that “competition from other memories blocks retrieval of a target memory” (Anderson 2000:226). The main assumption of interference theory is that the stored memory is intact, but that it is hard to retrieve due to a competition between memories acquired at different times. A daily-life example would be a situation in which one has made a packing list for a trip, but cannot find the list when it is needed. In remembering the items on the list by heart, each remembered unit imposes on and typically decreases the probability of remembering the other items on the list. In a situation with output interference, the retrieving activity in itself interferes with the retrieval of the information sought after. This is primarily caused by the limited capacity of the short-term memory.

How would output interference emerge in a search term selection process? The example provided in the previous section in connection with the winner-takes-all mechanism, also involves output interference. We have already seen that the winner-takes-all mechanism can trigger a *tip-of-the tongue* (T.O.T.) state: “[T]he winner-takes-all system can actually produce a retrieval block, and can, in particular, produce the pattern we have labelled the T.O.T. state” (Reisberg 2001:261).

Both the winner-takes-all mechanism and a variant of output interference can contribute to the situation which in information searching literature is called *the label effect* (Ingwersen 1992, 1996). The label effect describes “[t]he phenomenon that *request* formulations may often consist of one or several concepts which are of a more general nature or out of the context which constitutes the real information need” (Ingwersen 1992:229, italics original). It refers to the situation in which searchers choose topical descriptions which are out of the context that forms the real need. The words might be far too general, and the searcher might refer to only one out of several topical facets of a complex information need. Ingwersen (1992, 1996) establishes three categories of information needs; the *verificative* information need, the *conscious topical* need, and the *muddled topical* information need. The label effect typically occurs in muddled topical information needs, i.e. when searchers explore a topic they have little prior knowledge of.

Ingwersen describes the label effect as an “empirical fact that a conceptual ‘distance’ often exists between an information need, as represented in the actual user’s mind, and the user’s *request* formulation(s). Requests may consequently take the form of *labels*.”

(Ingwersen 1992:227, emphasis original). Nicolaisen (2009) discusses whether the label effect is a frequently occurring phenomenon or not, and claims that the empirical studies which reportedly have shown the phenomenon have several flaws. However, he does not disregard the phenomenon as such. The label effect as a phenomenon in information searching can be described from a psychological perspective as an example of output interference in which the act of remembering only one topical facet (i.e. the retrieval of specific information) decreases the probability of remembering the other topical facets of a complex information need (i.e. the retrieval of original information).

Another psychological mechanism associated to the phenomena described above, is the *anchoring effect*: "This term refers to the fact that, once an answer to a question is on the scene, people seem to use this answer as a reference point and select their own judgments only by making adjustments to this "anchor"" (Reisberg 2001:382, quotation marks original). The anchoring effect is described by Blair (1990) in an information retrieval perspective.[22] When people have to adjust the formulation or interpretation of a problem, they typically keep to their initial starting points. In an information searching context, a searcher has to try to predict which words have been used as descriptors or in relevant texts. If the first search query does not yield relevant results, searchers typically maintain the first search terms used and modify the search query by adding new terms to the original ones. The searcher will keep as many as possible of the first terms s/he selects, as an 'anchor set' of search terms. "This phenomenon explains why the inquirer is likely to maintain an anchor set of terms and to use it as a basis for formulating new search queries. [...] By keeping the anchor set intact (or by being willing to change it only as a last resort) the inquirer is, in effect, overestimating the probability of the conjunctive event that all the terms in the anchor set will be assigned to the document(s) he wants" (Blair 1990:17). Instead of considering to disregard the first stated search query, the searchers rather make small adjustments, typically in the last added terms (the very first term(s) is kept throughout the search session). The psychologist Kahneman (2011) claims that the remedy to avoid the anchoring effect to take place is the conscious dwelling and extra time spent on decision-making.

In my understanding of the anchoring and label effects, they are related, but not quite the same. Ingwersen (1992) refers to Blair (1990) several times, but not in association with the label effect – so he does not seem to claim a connection between the two. Whereas the

[22] Blair (1990) refers to the psychologists Tversky & Kahneman. Primary source (not consulted by me) is: Tversky, A. & Kahneman, D. (1974). Judgments under uncertainty: Heuristics and biases. In *Science, 185*, 1124-1131.

label effect characterizes searchers' tendency to express their information needs too generally or unilaterally, the anchoring effect characterizes the searchers' tendency to keep to their original expressed search queries. If these effects co-occur, one can easily understand that there will be a mismatch between user real information needs and the search results. In the data analysis in chapter 4, I will explore whether the data demonstrate the label effect and/or the anchoring effect.

2.5.5 Summary of psychological factors involved in information need formulation

The aim of this section has been to explain some of the psychological mechanisms involved in the information need formulation process, and state the reasons for why I have assumed them in the research design of the present project. Spreading activation theory has been introduced, drawing the line from psychology and linguistics to the application in information searching. Causes of recall problems relevant in the search term selection process have been briefly discussed in the last section. In the empirical study I will have these mechanisms in mind in the analysis and explication of the data material.

2.6 Integration of perspectives on meaning, information, and knowledge

The preceding sections of this chapter on the theoretical framework for my project have been permeated by the concepts of *meaning*, *information*, and *knowledge*. According to the conceptualistic approach to *meaning* applied in cognitive linguistics, the meaning of an expression is equated with a conceptualization in the mind of a language user – the meaning of a word is defined by its related conceptual knowledge. This statement implies that words cannot be understood isolated from larger conceptual knowledge structures. We have also seen that meaning is usage-based and a property of utterances, in that meaning emerges in the context of usage events. To sum up, meaning is identified with conceptualization and situated in language use.

Let us now recapitulate how I have used the concepts of *information* and *knowledge* so far in this thesis. I have applied the concept of *information* as it is used in information searching theory, and without further definition. I have been concerned with the information search process, more specifically the user revealment process in the formulating of information needs in the prefocus stage. I have also used the concept in association with concepts such as information seeking behaviour, information literacy training, and information technology. The concept of information has also been mentioned in association with cognitive linguistics and cognitive psychology, with respect to informational structures in the mind, and language as an instrument for organizing, processing and conveying information.

When it comes to the concept of *knowledge*, I have mostly used this in the collocation conceptual knowledge, as cognitive linguistics is very concerned with the representation and activation of conceptual knowledge. The concept of conceptual knowledge is necessary in order to study students who are in a situation in which they have to acquire terminological competence in a topical area which is new to them. Conceptual knowledge is contextual, i.e. contextual knowledge is obligatory in the interpretation of usage events. I have introduced Fillmore's frame semantics as a model of the representation of conceptual knowledge, and defined frame knowledge as the conceptual knowledge making up the context for a word.

In a conceptualistic approach, knowledge is individual and stored in the mind. In the field of information searching theory, when we perform knowledge organization, we try to capture and represent knowledge as it is stored in documents. When information searchers have an information need, there is a gap in their current conceptual knowledge which ideally should be filled by information found in documents. The ASK hypothesis (i.e. Anomalous State of Knowledge, cf. section 1.2.3 and Belkin, Oddy & Brooks 1982a) is formulated "in response to a situation where the information seeker feels a lack of success in creating a coherent, emergent, understanding around some phenomenon of interest and attempts to describe the shape of the gap in knowledge" (Bates 2005: Conclusion section).

Bates (2005, 2006) provides some useful definitions concerning the relationship between *meaning*, *information*, and *knowledge*. Bates (2005) aims at defining information and knowledge in an evolutionary framework for information science, inspired by evolutionary psychology and related initiatives. She also mentions the linguist Jackendoff (2002) which I referred to in sections 1.2.2 and 1.3.2. In her pursuits of pointing out a way of thinking about information that is suitable for theoretical and practical uses in the field of information science, Bates (2006:1042) arrives at the following definitions:

> • Information 1: The pattern of organization of matter and energy.
> • Information 2: Some pattern of organization of matter and energy given meaning by a living being (or its constituent parts).
> • Knowledge: Information given meaning and integrated with other contents of understanding

Semiotics applies the first definition of information, which is the basis which humans act upon in interpreting signs. *Information 1* is the pattern of organization of the material, the order in the system. Any information can potentially be informative, so information is everywhere except where there is total *entropy* (in the meaning “chaos, disorganization, randomness”).[23] When ‘patterns of organization of matter and energy’ is attributed meaning by a living being, it is defined as *information 2*. When this meaningful information is integrated with current contents of understanding, it is defined as *knowledge*. The definition of *knowledge as information given meaning and integrated with other contents of understanding*, is fully compatible with the comprehension of conceptual knowledge in a cognitive linguistic framework.

I conceive of the three definitions as a chain starting with *potential* information, furthering on to *meaningful* information and finally *integrated* information. When searchers have a gap in their conceptual knowledge, they face a wealth of information 1 (information external to the body of humans). Some information 1 is selected and assigned meaning as information 2. When this is integrated with the individual’s previously acquired information, it is defined as knowledge. So information searchers face *potential* information, assign *meaning* to some of it, and *integrate* it as new conceptual knowledge.

Bates identifies her approach as *constructive* and *emergent*. She states that information is the pattern of organization of matter and energy, and that these patterns “may be characterized as *emergent*, meaning that the sum of the elements constitutes something new, a whole with its own distinct qualities. Emergent phenomena are often dramatically different in character from the component elements that go into them” (Bates 2006:1034, emphasis original). This is in accord with what we have said about linguistic meaning, that it emerges in the context of usage events. This is called *emergentism*. Linguistic meaning cannot be calculated as the sum of meanings from the constituent parts of a usage event, but is rather constructed in the context of use and interpreted by the activation of conceptual knowledge. Construction grammar is a direction within the cognitive linguistic paradigm which is dedicated to the constructional nature of language (cf., e.g., Goldberg 1995, 2006).[24]

Bates (2005:17) concludes by stating that “to succeed in the process of developing a broadly applicable, encompassing understanding of information for our field, we must begin at the physical and biological levels and move up to the cultural, social, cognitive and aesthetic”. This is in accord with the concept of *embodied cognition* which was introduced in section 2.4.2: According to the experientialist position in cognitive linguistics, human reason is determined by our organic embodiment and by our individual collective experiences. Bates

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[23] Merruan-Webster at http://www.merriam-webster.com/.

[24] In my Cand. Philol. [‘Master’] thesis, I used a constructional approach in studying the semantics of the Norwegian sentence pattern called The Norwegian *Reflexive Caused Motion* Construction (Seland 2001).

identifies three fundamental modes of *embodied information*, i.e. information in *experience*, in *actions* in the world, and in *communicatory* expression. This "neural-cultural information is *encoded* in the brain and nervous system" (Bates 2006:1038, emphasis original). We note here that Bates, inspired by evolutionary psychology and cognitive psychology, refers to the *brain*. We saw in section 2.5.1 that the realm of cognitive linguistics concerns conceptual structures in the *mind*. However, these are conflating and not contradicting perspectives. This is fully compatible with the cognitive linguistic perspective of conceptual knowledge. Embodied information in Bates' terminology equals conceptual knowledge.

Bates (2006:1039) uses the concept of *exosomatic information* to refer to "information stored externally to the body of animals, [which] is a type of information that is core to the interests of information science". Exosomatic information is found as *embedded* information and *recorded* information. Embedded information is found in artefacts created by the actions of animals and people in the world, past and present. Recorded information is "communicatory or memorial information preserved in a durable medium" (Bates 2006:1039), created by the use of symbols which is primary to human beings. Embodied information (i.e. conceptual knowledge) creates exosomatic information (as artefacts and documents) as its durable result. In section 2.3.3 I discussed how meaning is decontextualized twice in the processes of knowledge organization and information searching. Using the terminology of the presentation above, the task of intermediaries (librarians or other information professionals) is to cater for a successful match between the searchers' conceptual knowledge gap – the missing embodied information – and exosomatic information available through recorded information in documents.

Since the beginning of the 1970s Wersig has taken an *effect approach* to information, defining information as the *reduction of uncertainty*.[25] In his 2003 article on information theory, he discusses why *complexity* is becoming increasingly important, and states that "[t]he integrated theory of information could in the near future be described as a theory of complexity reduction" (Wersig 2003:316). He concludes by being concerned with knowledge rather than information, when he presents the need for a deeper understanding of how complexity relates to knowledge structures.

I do not find it necessary to state where to draw sharp lines of similarities or differences between the conceptualistic understanding of meaning and Wersig's understanding of information and knowledge. I content myself with acknowledging that both approaches meet

[25] Primary source (not consulted by me) is: Wersig, G. (1971). *Information Kommunikation Dokumentation*. München – Pullack: Verlag Dokumentation.

in the concept of *knowledge*. In a conceptualistic approach, linguistic *meaning* is understood in relation to conceptual *knowledge*. In Wersig's layout, the reduction of complexity in *information* relates to *knowledge* structures. Then we are very near to Bates' definition of *knowledge* as *information* given *meaning* and *integrated* with other contents of understanding. Interestingly, the *titles* of the three models of the information search process (which was presented in section 2.2) coincide with the interpretations of *information* and *knowledge* which I have arrived at: Through guided inquiry, students' search for information is their pathway to knowledge.

With these interpretations in mind, I would say that the *semantic barrier* (cf. section 1.2.3 and Svenonius 2000) in information searching is the challenge faced by searchers who are in a state of uncertainty, driven by a desire to *seek meaning* (cf. section 2.2.1 and Kuhlthau 2004), when they strive to select information, attribute meaning, and integrate this as new knowledge in their current body of conceptual knowledge. *Meaning* and *information* is integrated in the concept of *knowledge*.

2.7 Summary of chapter 2 Theoretical framework

In this chapter I have presented the theoretical framework applied in this thesis, using information searching, cognitive linguistics, and cognitive psychology as points of departure. In the integration of these perspectives, I use a cognitive and contextual approach to my research topic of user revealment. In focusing on the individual cognitive context of the information need formulation process, I consider language as a mental phenomenon. This is not to say that I disregard the social aspects of language use, and that both individual and collaborative information searching is performed in a social context. It is just an emphasis of the focus in the present framework, which is the cognitive aspect of the information need elaboration process in the prefocus stage of information-based work tasks. More knowledge about this topic has consequences both for system performance (with respect to semantic tools), as well as information literacy training.

In section 2.2 I introduced three models of the information search process. A search task is embedded in an information search process which again is embedded in a work task. I concluded the section by presenting 8 terminological steps which I have arrived at to be able to make an empirical study of the prefocus stage. In sections 2.3-2.4 I presented the cognitive linguistic perspective of the representation, modelling, and activation of conceptual knowledge in information need formulation. I arrived at the concept of *frames* as the basic theoretical construct in the application of cognitive linguistic theory in the interpretation of the empirical data. In section 2.5 I discussed some psychological factors involved in information need formulation. I concluded my presentation of the theoretical framework in section 2.6, by making an integration of perspectives on meaning, information, and knowledge, drawn from information searching, cognitive linguistics, and cognitive psychology.

Chapter

3

Empirical study: Theory of method plus research design for the data collection

3.1 Introduction to research design and methodological approach

In this chapter I will present the theoretical basis for the methods used, as well as the research design. The data collection was done in two phases, referred to as the *Prearrangement study* and the *Revealment study*. In the Prearrangement study I collected word associations and relationship descriptions (collectively referred to as associative data) from university college teachers in the topical area of pedagogy. This was done in an effort to acquire linguistic expressions of experts' conceptual knowledge on the topic in question. The associative data was entered into a semantic network called PedNett, to be used as a semantic recognition tool in the Revealment study – as an idea generator for search term candidates. In this second phase of the data collection, university college students elaborated a simulated work task in several terminological steps, first without any semantic input, and then using PedNett. The informants were recruited from the Faculty of Education and International Studies at Oslo and Akershus University College of Applied Sciences[26], henceforth abbreviated OAUC/Edu.

A description of the data collection method was submitted to the Norwegian Social Science Data Services (NSD), cf. appendix 1[27]. Each informant signed a consent form prior to participation in the study. This was done at the outset of the informant sessions with the teachers, cf. appendix 2, translated in appendix 3. The consent form for the student informants was included as a part of the pre-session questionnaire which the students received when they

[26] The name of the faculty and the university college at the time of data collection was the Faculty of Education at Oslo University College.
[27] The ethics protocol of approval is in Norwegian, and this appendix is not translated word by word. It states that the handling of personal data from the informants in the present project meets the requirements stated in the official regulations.

were recruited to the study, and which they handed in at the beginning of their main session, cf. the fourth page of appendix 11, translated in appendix 12.

In section 3.1 I will provide some introductory remarks on the methodological approach used, before I will lay out the specific choices made in the overall research design (cf. section 3.2). Section 3.3 will provide an in-depth description of the Prearrangement study, including theory of method, data collection, description of the nature of the collected data, as well as considerations on shortcomings in the research design. Section 3.4 will comprise a similar content concerning the Revealment study. Section 3.5 will provide reflections on the integration of my theoretical framework and the empirical study, before I sum up this chapter in section 3.6.

My aim for the empirical study has been to gain a deeper understanding about the complexities concerning my research topic, namely students' formulation of information needs in the prefocus stage. I believe in "the value of detailed, descriptive data in deepening our understanding of individual variation" (Patton 2002:16). In the research design I have applied a bottom-up and context-dependent approach. I have used multiple methods both when it comes to the alternation between in-depth analysis of single persons and surveys of complete groups of informants (cf. the question of case-study research below) – as well as qualitative and quantitative features concerning data collection methods, kinds of data, and analysis methods.

3.1.1 Case-study research

Case-study is an approach for empirical inquiry in which the researcher explores developmental factors of a phenomenon, e.g., a person or an event. This research strategy can be used with both qualitative and quantitative data. Flyvbjerg (2007) provides the following *guidelines concerning case-study research*:

> 1) Predictive theories and universals cannot be found in the study of human affairs. Concrete, context-dependent knowledge is therefore more valuable than the vain search for predictive theories and universals. (p. 393)
>
> 2) One can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods. But formal generalization is overvalued as a source of scientific development, whereas 'the force of example' is underestimated. (p. 395)
>
> 3) The case study is useful for both generating and testing of hypotheses but is not limited to these research activities alone. (p. 395)
>
> 4) The case study contains no greater bias towards verification of the researcher's preconceived notions than other methods of inquiry. On the contrary, experience indicates that the case study contains a greater bias towards falsification of preconceived notions than towards verification. (p. 399)

> 5) It is correct that summarizing case studies is often difficult, especially as concerns case process. It is less correct as regards case outcomes. The problems in summarizing case studies, however, are due more often to the properties of the reality studied than to the case study as a research method. Often it is not desirable to summarize and generalize case studies. Good studies should be read as narratives in their entirety. (p. 401-402)

Flyvbjerg himself recommends a combination of depth (case-study) and breadth (large samples) for a sound research strategy: The guiding principle should be "problem-driven and not methodology-driven, in the sense that it employs those methods that for a given problematic [sic.] best help answer the research question at hand" (Flyvbjerg 2007:402). When it comes to the selection of case studies for in-depth analysis, a typical or average case does not necessarily represent the case which is richest in information. An atypical or extreme case may reveal more information. A case suited for in-depth analysis provides rich information in that it activates several actors and reveals basic mechanisms in the situation studied.

My aims for the research design and analysis are compatible with case-study research. Inspired by Flyvbjerg's (2007) discussion, I would like to establish five guidelines for my empirical study: 1) collect concrete, contextual knowledge to be used in a case-study, 2) make a careful selection of cases which will be subjected to in-depth analysis, with a basis in my research questions, 3) include critical cases but be cautious in seeking causes and consequences for them, 4) consider the aim of the inquiry to be understanding and learning of phenomena (rather than proving of hypotheses), and – last but not least – 5) include complexities and contradictions, just as in real life.

In point 3 I am more reserved than Flyvbjerg. I will not generalize on the basis of a single case. My informants were collected with one criterion for the whole group. For making a generalization on the basis of a single case, this informant should represent a specific aspect when s/he is recruited – not post hoc during the analysis. I have strived to proceed with the research inquiry according to these principles. When studying users' information behaviour, it is important to clarify the causes behind and consequences of their challenges in formulating information needs, rather than to describe symptoms and report on frequencies. I want to explore these matters via logging of users' behaviour during informant sessions, as well as their self-reporting at the end of the sessions.

3.1.2 Qualitative versus quantitative methods

Empirical studies need not be *either* qualitative *or* quantitative. Patton (2002) reports on an increase in the use of multiple methods, where we find combinations of qualitative and quantitative data. Qualitative versus quantitative methods can be seen as two endpoints of a scale – a continuum along which the actual research studies are found. Qualitative and quantitative data are useful for different purposes. If I want to know how many words students on an average use in different stages when they elaborate their information needs, I can restrict myself to counting those words. However, if I want to learn about affective, cognitive, and physical aspects of the information need formulation process, I have to consider different methods, like observing and logging actual behaviour, as well as interviewing the informants or using open-ended questionnaires. I have used a combination of these methods, as will be described in the following sections.

In chapter 4 on analysis of the empirical data, I will use some descriptive statistics to present an overview of the data material and main findings, before I enter into an in-depth qualitative analysis. In analysing the data, I have looked for *patterns* – not for statistical correlations or significance results. These patterns are understood as meaningful structures or themes which will be subject to further study. This follows from my choice of method for the data collection. My aim is not hypotheses testing, but an increased understanding of the factors involved in prefocus information need formulation. In this complex issue I use my research questions as guiding principles in the analysis and in the subsequent discussion.

So is the present project a qualitative or a quantitative study? My methodological approach is predominantly qualitative. My aim is primarily to describe and understand the object of study, i.e. prefocus information need formulation – not to find causal or general explications. Most of the data collection methods, kinds of data, and analysis methods which I have used are associated with the qualitative end of the qualitative-quantitative method continuum.

3.1.3 Interpretive field studies

Klein & Myers (1999) state that qualitative research can be labelled as interpretive, critical, or positivist – depending on the underlying philosophical assumptions of the researcher. I consider my approach as interpretive, which is characterized by an assumption that "our knowledge of reality is gained only through social constructions such as language, consciousness, shared meanings, documents, tools, and other art[e]facts" (Klein & Myers 1999:69). In interpretive research no variables are predefined. The focus is on the complexity of human sense making and emerging situations. Phenomena are interpreted in relation to the meanings people assign to them. Interpretive methods are aimed at understanding processes and the context in which they evolve. Klein & Myers (1999:72) present a set of seven principles for conducting and evaluating interpretive field studies: 1) the fundamental principle of the hermeneutic circle, 2) the principle of contextualization, 3) the principle of interaction between the researchers and the informants, 4) the principle of abstraction and generalization, 5) the principle of dialogical reasoning, 6) the principle of multiple interpretations, and 7) the principle of suspicion.

The principle of the hermeneutic circle is fundamental to all the other principles. This first principle suggests that "all human understanding is achieved by iterating between considering the interdependent meaning of parts and the whole that they come from" (Klein & Myers 1999:72). The second principle concerns the awareness of the context in which the research is performed. We note that this resembles the first guideline of Flyvbjerg (2007), which also deals with context. However, Klein & Myers' principle concerns the attitude the researcher should take in interpreting the empirical data (i.e. be aware of the social and historical background), whereas Flyvbjerg's guideline concerns the selection of cases (i.e. concrete and context-dependent). The third principle of Klein & Myers is a reminder of how the empirical data are constructed in an interaction between the researcher and the informants.

The fourth principle concerns the relating of details in the empirical data to general concepts that describe the nature of human understanding. The fifth principle requires the researcher to be sensitive to possible contradictions between the theoretical preconceptions guiding the research design and actual findings. The sixth principle concerns the possible differences in interpretations among the informants, i.e. different persons might account for the same situation in multiple ways. The last principle is a call on the researcher to be sensitive to possible biases and systematic distortions in the empirical data.

To sum up my methodological approach, I will perform a predominantly qualitative study, using case-study and interpretive strategies. I am inspired by Flyvbjerg's (2007) guidelines for case-study research as well as Klein & Myers' (1999) principles for interpretive field research.

3.2 Overall research design

In this section I will present the choices which I have made concerning the overall research design. This will be followed by two sections which will contain in-depth presentations of each of the two phases of the empirical study, i.e. the Prearrangement study (cf. section 3.3), and the Revealment study (3.4).

3.2.1 Selection of topical area and informants

As presented in chapter 1, I am interested in how students develop their terminological understanding in the course of information need elaboration, which again is embedded in their process of gaining knowledge in a topical area which is new to them. I chose educational science, more specifically the topic of *pedagogy,* as my empirical area of application for the data collection. The informants were recruited from the pre-school and general teacher education programmes at OAUC/Edu. Norwegian was used in all parts of the data collection and later analysis. Details and justification for these choices are discussed below.

Many considerations lead to my choice of *pedagogy* as the empirical area of application. The most important criterion was that I wanted a topical area which had a terminology consisting primarily of words which are found in ordinary language use. By this I mean words which are found in the vocabulary of most speakers in a language community, but at the same time – in a specific area of application – these words are ascribed topic-specific associations and get a professional use. At first I considered whether I should recruit informants from my own institute, covering library and information science. However, the topical area of information science would only meet the above mentioned requirements to some extent. Furthermore, I found it not to be suited for the purpose because the informants would have educational training in the information behaviour which I wanted to study.

So I wanted the informants to handle a terminology of which they had a colloquial language use understanding before they embarked on their studies. Pedagogy, from the educational science field, is an example of a topical area meeting these requirements. Consider, e.g., *motivation*, *learning,* and *teaching* – these are examples of words of which anyone – also outside the educational or professional area of application called pedagogy – will have a preconception. Other examples of topical areas which I consider to have a terminology containing words from colloquial speech which are ascribed specific meanings in specific application areas, would be literature science or communication studies. These examples are opposed to topical areas like, e.g., anatomy, pharmacology, or physic, which in my opinion are topical areas which have more specialized terminologies, often fetched from Latin or English.

A welcome side-effect of my choice of *pedagogy* as the area of application in the empirical study, was that it made it possible for me to handle the terminology without expert help. For economic reasons I would not have access to expertise in the coding and analysis of the data material, so I needed to have a certain educational background in the topical area, and/or the terminology should be possible to handle without extensive prior studies. I have taken a course in pedagogy for university college teachers, and I used the dictionaries *Pedagogisk ordbok* (Bø & Helle 2008) and the dictionary *Norsk-engelsk ordbok for grunnopplæringen* (Utdanningsdirektoratet 2011) as primary reference tools in handling the terminology in the empirical data.

In the Prearrangement study I needed *experts* in the topical area of pedagogy, defined by me as university college teachers holding a master or PhD degree in either pedagogy or special pedagogy. Considering the practical advantage of recruiting informants from my own campus, I established collaboration with OAUC/Edu. This also gave me a population to recruit from with many potential informants, as OAUC/Edu has the largest teacher education programme in Norway. In the Revealment study I wanted to recruit *novices* in the topical area of pedagogy, defined in the present research design as second year educational science students at OAUC/Edu. I wanted to recruit students who studied pedagogy in the context of a teacher education programme, not as a university course. This provided me with informants who had an applied perspective of pedagogy and were used to having work tasks during the semester related to teaching situations.

3.2.2 The two parts of the empirical study: Prearrangement and Revealment

The data collection of the empirical study was performed in 2009, in two phases. The Prearrangement study took place during the period from January until March, whereas the Revealment study took place during three days primo May 2009. The selection of the names *Prearrangement* and *Revealment* studies were chosen for ease of reference in the description of the empirical study. These names also suggest the different roles of the two stages. Prearrangement is used to refer to the fact that the first phase of the empirical study (the development of the semantic network PedNett) is *prearranged*, i.e. ‘something arranged in advance’. That is, PedNett was just a prerequisite for the implementation of the main part of the study, which was the *revealment*. Revealment, in turn, refers to the concept *user revealment* which was presented and discussed in section 1.2.1. We note that the Prearrangement study concentrates on *the tool* (i.e. PedNett based on teachers’ associations) which is employed in the Revealment study of *the users* (i.e. student informants).

In the Prearrangement study I employed the word association method to collect word associations and relationship descriptions from teacher informants. This was done in an effort to ‘tap’ the teachers’ frame knowledge in the form of linguistic expressions. The associative data were used to make a data-based semantic network (called PedNett) in the topical area of pedagogy. The PedNett database was used in the Revealment study with university college students of educational science. In the test sessions the student informants were asked to formulate and organize an assignment in several steps, eliciting topics where they had acquired an information need due to the work task assignment, arriving in the last step at a formalized information need. This was done twice – without and with the input from PedNett, respectively.

3.2.3 Sampling strategy in the empirical study

The empirical study employs several sampling strategies, and it also includes multiple types of data. In the Prearrangement study with the teacher informants, I used *criterion sampling*, with the criterion ‘university college teachers holding a master or PhD degree in either pedagogy or special pedagogy’. In the Revealment study, I used a combination of *criterion sampling* and *maximum variation sampling*. The criterion used was ‘second year educational science students’. Maximum variation was secured by recruiting all the students from each class participating in the study.

Criterion sampling is a kind of *purposeful sampling*. Purposeful sampling is one out of four important sampling procedures in qualitative research according to Gobo (2007), the other three being quota sampling, the emblematic case, and snowball sampling. Patton (2002) makes a distinction between purposeful sampling and random probability sampling. Patton provides a catalogue of 16 different kinds of purposeful sampling. Of particular relevance to me are the categories *criterion sampling* and *maximum variation sampling*. In criterion sampling, one picks all cases that meet some criterion, with the purpose of quality assurance in the data collected.

In maximum variation sampling, one purposefully picks a wide range of cases to get variation on dimensions of interests. With this approach one can identify central themes and important common patterns in the data material. According to Patton (2002), a maximum variation sample should be selected according to characteristics from within the group – e.g., geographic distribution in a study of media use. The composition of student classes in itself represents the maximum variation of characteristics among informants when it comes to characteristics like age, gender, level of learning, and learning style, so I can assume that each class is composed of students who represent important common patterns among the category they are selected from (i.e. second year educational science students). In recruiting full classes, I would ensure to keep this variation.

When it comes to the number of informants, Patton (2002:244) states that "[t]here are no rules for sample size in qualitative inquiry. Sample size depends on what you want to know, the purpose of the inquiry, what's at stake, what will be useful, what will have credibility, and what can be done with available time and resources". I recruited three full classes of student informants due to one practical and one methodical reason: When I approached the section of pedagogy with a wish to use one hour of their lecture time for informant sessions, three teachers responded to my application – so this provided me with a suitable number of informants. Furthermore, recruiting *all* the students from each class, secured a maximum variation sample.

3.2.4 Norwegian language use in all parts of the data collection

I wanted no translation involved in either part of the data collection or the analysis; therefore Norwegian was used in all parts of the data collection. This implied informants with Norwegian as their first language, performing the informant sessions in Norwegian. The teacher informants in the Prearrangement study should be making word associations to Norwegian stimuli words, whereas the student informants in the Revealment study should be using a Norwegian semantic network (i.e. PedNett) and answering Norwegian questionnaires. With this requirement, it is an advantage that the topical area of pedagogy is taught with a curriculum in Norwegian at OAUC/Edu. Furthermore, OAUC/Edu has a separate general school teachers' education for bilingual students who are going to give first language training to pupils who have Norwegian as their second language. Thus, recruiting from the main pre-school and general teacher education programmes, I mostly got students with Norwegian as their first language. There was one student with two mother tongues (Norwegian and Urdu), one with Danish, and one with Swedish as their first language. These students all used Norwegian with first-language proficiency when they filled out the questionnaire during the informant session, accordingly they were included in the sample of n=54.

The reason for the language criterion is based on a consideration done on linguistic grounds. In using language processing and linguistic material as an indication of how informants process information needs, I do not want to add translation as a complicating matter, which I think would blur the data I want to analyse. In section 2.4.2 on the relationship between language and thought, I referred to the Sapir-Whorf hypothesis of linguistic relativity, which is concerned with the fact that languages vary with respect to how conceptual knowledge is expressed by linguistic categories. As I will present in the methodological setup, I consider word associations to be one way to reveal aspects of the frame knowledge attached to words. Based on a conceptualistic understanding of linguistic meaning potential – with the meaning of words understood in relation to frame knowledge – one has to acknowledge that there is no one-to-one translations between words in different languages. The knowledge associated with a pair of words used as translation equivalents between different languages, will never be identical, neither in the language community nor in the individual speaker. This is of course why translation is such a tricky task.

Students in the process of acquiring an understanding of a topical area which is new to them, experience a constant change in their conceptual knowledge. The associations related to words they already know are enriched by topic-specific meaning potential. They also have to include new words in their individual vocabulary, associated with frame knowledge based on the topic in question. The meaning potential associated with these words will be different for novices versus experts in a topical area. There will even be individual differences between each language user. Every student meets the topical area with their individual conceptual knowledge as the context into which new knowledge will be gained. In the course of their education, the students are supposed to acquire the common understanding of the terminology within the area-specific language community. I study information need formulation in students who are in this process of developing their conceptual understanding of a topical area, being confronted with different ‘languages’ on the novice-expert continuum (concerning the amount of and type of knowledge).

I find it orderly not to blur the data analysis with different national languages, as this would add another variable, namely the informants’ foreign language proficiency. I use the term *variable* to refer to characteristics along which I can group the data (not as a term from the universe of statistics). I am well aware that it is rather common to conduct empirical studies on information searching behaviour with informants using information systems in a language which is not their mother tongue. This is well justified in studies of information behaviour in a social context. After all, this is a common situation for information searchers to be in. However, this would be more complicated in my approach, as I study the cognitive context of user revealment. The handling of different languages triggers different sets of associations, which could lead to differences in information need formulation. This is the reason why I did not use Knapp’s (2000) thesaurus (discussed in section 2.5.2) in the

Revealment study – though I seriously considered it – and decided instead to establish the Norwegian semantic network PedNett for the purpose.

3.2.5 Summary of the overall research design

In section 3.2 I have justified the selection of pedagogy as my empirical area of application, with teacher and student informants recruited from OAIC/Edu. The two parts of the empirical study are called the Prearrangement study (i.e. word associations with teacher informants, plus elaboration of the semantic network PedNett) and the Revealment study (i.e. student informants formulating an information need embedded in a simulated work tasks). I have presented the sampling strategy, as well as justified the use of Norwegian language in all parts of the data collection.

3.3 Prearrangement: The tool. Elaboration of the semantic network PedNett

In my explorations of how users reveal and formulate their information needs before they start searching, my second research question is: How do students in the prefocus stage utilize teachers' frame knowledge expressed as word associations and relationship descriptions in the semantic network PedNett? That is, how will students react to being exposed to experts' (i.e. their teachers') linguistic expressions of frame knowledge related to pedagogic terminology? The potential benefit for the students will be influenced by several aspects, e.g., the students' current frame knowledge and terminological competence in the topical area, and whether they have worked with the topics presented in the simulated work tasks before.

From a linguistic perspective, all kinds of language processing will contribute in the activation of students' current knowledge. Why exactly choose the idea of confronting the students with experts' frame knowledge expressed as word associations and relationship descriptions? This is justified by a reasonable assumption that the teachers' frames will be richer, and they have a more entrenched vocabulary, because of their topical area expertise and experience. The students' vocabulary will be more scattered and meagre than the experts', because the students are novices in the topical area.

So I wanted to explore whether or how the students could benefit from the experts' word associations, produced together with descriptions of the relationship between each pair of stimulus and response word. *Word associations* and *relationship descriptions* are in the context of the present empirical study collectively referred to as *associative data*. To be able to explore these matters, I wanted to collect associative data from experts in the topical area of pedagogy. The associative data was entered into the semantic network PedNett, and presented to the students elaborating simulated work tasks. The compilation and use of PedNett is based on an assumption that novices (students) in the topical area of pedagogy can benefit from being exposed to associative data produced by experts' (teachers), in the manner that the students might *recognize* words as relevant which they do not *recall* on their own.

In this section covering the Prearrangement part of the empirical study, I will first give a presentation of some basic tenets of the word association method in psychology, and how word association testing has been applied in the field of information searching (3.3.1). I will then go on to describe how the data collection was performed in this study (3.3.2), before I comment on the nature of the resulting empirical data (3.3.3). In the subsequent section I will present how the semantic network PedNett was elaborated (3.3.4), before I present the characteristics of PedNett (3.3.5). In sub-section 3.3.6 I will reflect on the shortcomings of the design of the Prearrangement study, before I summarize this section in 3.3.7.

3.3.1 Theory of method in the Prearrangement study: Word association testing

In this section I will present some central theoretical aspects of word association testing and how this method has come to be used in information searching research. The word association method is originally a method used in psychology and psycholinguistics (Aitchison 2012), and is described in standard works like Cramer (1968) and Deese (1965). Lykke Nielsen (2002) used the word association method in the field of information retrieval. The word associations provided by her informants were used as input terms in an associative thesaurus with classical thesaurus relationships. The categorization of terms into relationships was done in the data analysis.

The application of word association testing in the present project is according to the psychological theoretical construct of *relevance,* understood as access points to our 'knowledge of the world' (Kiss 1975). I draw a parallel between this understanding of 'what goes with what' connections and Fillmore's (1975) theoretical construct of *frames* of conceptual knowledge. The theoretical construct of relevance leads to the assumption that word associations can be used to elicit individuals' use and understanding of words in a given topical area – i.e. associative data can be used to elicit frame knowledge.

3.3.1.1 Word association testing in psychology

The theories and practice of word association testing originated in the field of psychology and psycholinguistics (Aitchison 2012; Cramer 1968; Deese 1965; Lykke Nielsen 2002), based on the assumption that verbal associations can elicit the nature and structure of the mind, because associative processes are basic to the understanding of thinking. Word association testing is used “to reveal the private world of an individual” in the manner that the word associations “reveal the respondents’ mental model of word networks, verbal memories, thought processes, emotional states, and personalities” (Lykke Nielsen 2002:51). Deese (1965) traces the philosophical and psychological antecedents of current association theory back to the early Greek philosophers and their development of the ‘laws of association’ in their attempt to explain the sequence of ideas in a train of thought. Cramer (1968) is reckoned to be the first monograph devoted entirely to word association testing, and it contains an overview of the literature on word associations published between 1950 and 1965. There was a renewed interest in word association testing in the 1960s due to an increasing interest in cognitive processes and verbal behaviour. “The method was considered to be a valuable source to the study of the relationship between associative strength and other cognitive functions from the viewpoint that thinking is partly associative, and stimuli-response associations reflect units of thought” (Lykke Nielsen 2002:53). Psychological studies using this method have resulted in standard lists of word associations, referred to as *norms of word association* containing, e.g., frequency of occurrences, word length, abstraction level and grammatical class. One example is found in Postman & Keppel (1970).

Word association testing is very simple in that the researcher can obtain a large amount of semantic information in a short time. Normally, the respondents have one minute to provide their associations to the stimulus word. (Here I use *respondents,* instead of *informants,* in accordance with the literature on word associations. *Test persons* are also frequently used in descriptions of word association testing). The body of response words from all the respondents creates clusters of words which are associatively related to each stimulus word. It is assumed that the method exposes the respondents’ mental representation related to the stimulus word, in a user-oriented word structure. Though the data collection is simple, however, the analysis of the empirical data can be time-consuming, depending on how they are processed. The data can be analysed word by word as an intellectual process by the researcher, e.g., making decisions about the kinds of relationships between the stimulus word and the response words. A less time-consuming analysis of the data is statistically processing, e.g., calculating frequency of occurrences and word length. Choice of analysis method and the nature of the results are naturally guided by the research questions in each study.

Deese (1962) investigates the distribution of stimulus-response word pairs with the stimuli and response words from the *same form class*, versus from *different* form class. He finds that the form class of the stimulus word is predictive for the variation of the form class belongings of the response words, in stating that "in free associations obtained from adults, the responses are generally of the same form class as the stimuli" (Deese 1962:79). For example, a noun stimulus word typically yields a noun response word (*cat – dog*), whereas an adverb stimulus word typically yields an adjective (*amazingly – strong*).

3.3.1.2 Degree of control, presentation of stimuli words, and priming

When planning a word association test, several methodological considerations and choices have to be made. One is the distinction between a *free* versus *controlled* association test. In a free association test, the respondents are allowed to associate freely. In a controlled test (also called a restricted test), the respondent "must choose his response from a restricted domain of responses specified by the experimenter" (Cramer 1968:14). Examples of restrictions are relationship type (e.g., that the response word must be superordinate to the stimulus word), or semantic category (e.g., that the response word must be the name of a colour). In the present project, a *free* association test was used.

Within the free-association method, there are several test methods for the presentation of stimuli words; *discrete*, *continued* or *continuous*. In a discrete test the respondent must associate one response to the stimulus word which is presented once. In a continued test the respondent is presented with the same stimulus word several times, and must associate one response word each time. In a continuous test the stimulus word is presented only once, and then the respondent must provide a chain of several word associations. In the present project, a continuous test was used in the empirical study. Each of the three mentioned methods has several variants which are described in (Cramer 1968). One has to be aware of the pros and cons with each alternative method. In using a continuous test method, the respondents have a tendency to associate their response words to the last given response word, rather than to the stimulus word (Lykke Nielsen 2002). On the other hand, the *free* aspect of the association test is emphasized when the respondent is allowed to produce associations undisturbed during the response interval allowed (typically one minute). Lykke Nielsen (2002:65) recommends a continuous test method, referring to one of her earlier studies (Lykke & Skrubbeltrang 1992) in which she experienced that “the test persons found it easier and more comfortable to associate three relations at a time”.

The associative environment in a test situation can be controlled by the verbal context preceding the stimuli words. This is called *priming*, and it is a way of making influence on the likelihood of a given type of response words to be produced. “Most generally, priming may be defined as a change in antecedent conditions which is specifically designed to increase the probability of a particular response, B, being given to a particular stimulus, A” (Cramer 1968:82). Cramer makes a distinction between direct priming and indirect priming. Direct priming is accomplished by presenting the respondent with the desired response word (e.g., in linguistic training of amnesic patients). In indirect priming, the priming words are associatively related to the desired response. Priming is normally used in controlled tests. In the research design of the present study, priming was not used except from explicit information about the purpose of the test.

3.3.1.3 What goes with what: Kiss’ relevance compared with Fillmore’s frames

In an attempt to integrate psychological and linguistic research on associative relationships in our conceptual knowledge, I will in this section draw a parallel between Kiss’s (1975) psychological theoretical construct of *relevance* as access points to our ‘knowledge of the world’, and Fillmore’s (1975, 1977a, 1977b, 1985) theoretical construct of *frames* representing conceptual knowledge. Kiss represents the word association research in psychology. Fillmore’s frame theory was presented in section 2.3.1 as part of the cognitive linguistic framework used in this thesis.

Kiss (1975) maintains that relevance – understood as knowledge about the ‘what goes with what’ connections – is an important aspect of our knowledge of the world. In my opinion, his descriptions of relevance connections resembles Fillmore’s concept of frames, as an integrated part of our conceptual knowledge. Interestingly, Fillmore developed his theory of frames in the 1970s, at the same time as Kiss claimed the importance and nature of the ‘what goes with what’ connections, without any of them referring to each other. Furthermore, Kiss states that this kind of knowledge is not all that we need. “In addition to knowing that chair goes with table, we also need to know a great deal of information about the relational (logical) nature of the connection” (Kiss 1975:108). In our memory we carry extremely large amounts of relational information, and Kiss argues for a clear distinction between on the one hand the functions of generating alternative possibilities (associations), and on the other hand deliberating and reasoning about them. This reasoning is based on relevance, and "two things are relevant to each other when given one of them, the other may also need to be considered or taken into account in some way. A knife is relevant to bread, because it could be used for cutting it. Scales are also relevant because they could be used for weighing it" (Kiss 1975:108).

We saw with frames that constituent parts of a frame can be more or less central, depending on matters such as context of use and frequency. Kiss makes a similar claim when he states that knowledge of the world in the form of 'what goes with what' connections is a matter of degree. "It is easy to decide that knife is more relevant to bread than scales are. Why we feel this to be so probably has a number of reasons, including frequency of association, essentiality, etc." (Kiss 1975:108). Kiss goes on to claim that word associations are direct indicators of degrees of relevance between conceptual knowledge labelled by the words. According to the approach used in the present project, word associations are considered as indicators of connections within our conceptual knowledge, i.e. they are indicators of the structure of the organization of our minds. Word associations are "an index of our knowledge of the world. They are the keys to the retrieval processes of our memory" (Kiss 1975:118). Kiss emphasizes that though the associations are represented as connections between words, they are not a purely linguistic phenomenon, "particularly if we accept that the main uses of words are as labels and 'handles' for concepts, which are, in turn, our main cognitive structures for knowledge" (Kiss 1975:118, apostrophes original). With this perspective on word associations and what they represent, I find it justified to say that *word association testing can be used empirically to elicit frame knowledge*, which is made up by clusters of conceptual knowledge.

In claiming that word association testing can be used to make written representations of mental frames, this is not to say that I consider the frames to be represented in their entirety. Naturally, no complete frame can be elicited, because of the nature of the word association test method (one minute response per stimulus word, the first word(s) that comes into your mind, etc.). Also, it is impossible to define the outer limits of frames. The mental web of connections makes it impossible to tell where one frame ends and another one starts. Furthermore, frame knowledge is an individual mental phenomenon – no complete frame is shared between two language users. It should be kept in mind that word associations are made by individuals, but in the analysis they are collected from several informants, whether it is in lists containing 'norms of word association', or e.g., as in information searching, used as entry vocabulary in searching thesauri. Word associations in use represent conventional associations, i.e. representations of associative knowledge collected from several respondents. This is parallel to the situation of traditional dictionaries, which also contain conventional meanings of the word entries. In my project, I experiment with word associations as a source of frame knowledge, and the semantic network PedNett as a way to represent this knowledge.

3.3.1.4 Word association testing in the field of information searching

As already noted, word association testing is originally a method used in psychology and psycholinguistics (Aitchison 2012), to reveal the respondents' mental representation of semantic networks based on the assumption that thinking is partly associative. The method has only to a little extent been employed in information searching research. Empirical projects in this field can be characterized by the way the associative data provided by the informants are used. Common to most projects in this field, is an effort "to capture the users' active mental models and understanding of the knowledge domain in which they are operating with the aim of integrating this knowledge into the systems' interfaces and searching tools" (Lykke Nielsen 2002:52). The intention has been to make retrieval systems more user-friendly by integrating vocabulary provided by topical experts, as a semantic tool for peers or novices.

An overview of 10 empirical projects in information searching applying word association testing in the period from 1962 to 1997 is provided in Lykke Nielsen (2002:56-57). These projects indicate that word association testing is useful for the identification of vocabulary used by a limited group of people within a topical area. When it comes to how the respondents' associations are structured, most of these projects applied the principles of relevance as used in psychology (e.g., Lykke Nielsen herself). The relevance approach was applied to identify related words, entry vocabulary, or for the purpose of query expansion, or combinations of these three purposes. An additional purpose which is specific for information search projects using word association testing (as opposed to word association projects in psychology), is to use word association data "to identify language use of the respondents, e.g., their use and understanding of terms and their terminological choices regarding word types and forms" (Lykke Nielsen 2002:56). This aspect is highly relevant in the research design of the empirical study in the present project. The application type of my project is according to the principle of relevance, based on the assumption that word associations provide insight into how units are structured in the conceptual knowledge of individuals. This is done to identify the informants' use and understanding of words in a given topical area.

Lykke Nielsen (2002) took the use of word association testing in the field of information searching one step further in the elaboration of a method for the development of a searching thesaurus. A searching thesaurus is intended for search term selection or revision. Word associations were provided by topical experts in the area of pharmaceutics. The word associations were used as input to enrich an existing thesaurus categorized into classical thesaurus relationships (broader terms, narrower terms, related terms, and synonyms). The word associations were distributed on all the four categories, particularly the related term category. This was done in the data analysis, not by the informants. So the raw material of thesaurus term candidates was provided by the informants, whereas the structuring of the thesaurus was initiated by the researcher as part of the data analysis. A researcher who applies word associations as raw material in a searching thesaurus should be aware that "[t]he associations may point in several distinct directions, and the response words should be considered as ideas or inspiration for a wider investigation of context, coherence and completeness" (Lykke Nielsen 2002:74).

Informants can provide not only word associations, but also descriptions of word pair relationships. Spiteri (2005) used word associations as raw material for thesaurus construction in the topical area of knowledge organization. In her study the informants (library and information science students) were asked to refer to – in their own words – the relationship between the stimulus word and each response word, after having made their word associations. The informants were provided with examples of how they could refer to the relationships, like 'is a part of', or 'is the product of'. In the data analysis, Spiteri categorized the relationships into the classical thesaurus relationships, with a refined inventory of related terms, i.e. associative relationships. Morris (2007) also prompts the informants to provide relationship descriptions. However, this is not in a word association test, but in a test of readers' perceptions of lexical cohesion in text, in which each word pair was to be referred to by a relationship description.

3.3.1.5 Summary of theory on word association testing

In section 3.3.1 I have presented the approach of word association testing. This method originated in psychology, but has come to be used in information searching. The concepts of degrees of control, presentation of stimuli words, and priming were presented. These are issues which have to be considered when planning a word association test. The psychological concept of relevance (Kiss 1975) as access points to our knowledge of the world was compared with the cognitive linguistic concept of frames (Fillmore 1975, 1977a, 1977b, 1985). This section was concluded by a discussion of how word association testing has been used in the field of information searching.

3.3.2 Collection of word associations and relationship descriptions from teachers

I conducted the word association testing with 12 teacher informants in my office, as one-to-one sessions with me and each informant. Three of the informants had two sessions, resulting in 15 sessions with a total duration of 20 hours. The length of the sessions depended on what the informants agreed to when they were recruited, resulting in five sessions of two hours, and 10 sessions of one hour. The teacher informants in the Prearrangement study produced word associations and descriptions of relationships between pairs of words, writing at a computer. All the teacher informants used standard Norwegian in writing. The resulting raw material was organized in tables, cf. appendix 4 for an example. An edited version is reproduced as appendix 5. I corrected the body of text in these tables for spelling errors before I entered it into an SQL database structure created for this purpose and used by the PedNett database.[28] The resulting semantic network, which I call PedNett, was used as a tool in the Revealment part of the empirical study.

In each informant session the teachers went through the following seven stages: general information, consent form, production of candidates for stimuli words, test procedure information, word association testing, informant fee, and summing up. The sessions were sound recorded because I wanted to be able to track back whether the informants exercised ‘think-aloud’ while they produced word associations and relationship descriptions. Some of they did – spontaneously, not due to any instruction. The table below describes each stage of the procedure:

[28] I am greatly indebted to Michael Preminger for programming the SQL structure for the PedNett database. He is an Associate Professor at the Department of Archivistics, Library and Information science at OAUC.

Procedure stage	*Activity*
1) General information	Information on the study, situating the word association testing as part one of the empirical study – the establishment of PedNett as a prerequisite for the student informant sessions. Aim of session: production of word associations and relationship descriptions between stimuli and response words.
2) Consent form	Signing of consent form. Agreement on recording of the session.
3) Candidates for stimuli words	Production of 20 central words from the topical area of pedagogy, which are focused in their own lectures. To be used by me as candidates for stimuli words. Cf. section 3.3.2.2 on choice of stimuli words.
4) Test procedure information	Explanation of the test procedure.
5) Word association testing	The actual word association testing, performed in writing at a computer, in a Word table. This took up 90 % of the session time.
6) Informant fee	The teacher informants were paid a fee of 250 Norwegian crowns an hour, in the form of a voucher for the campus book store.
7) Summing up	The teacher informants were asked whether they were willing to participate in a second informant session, and whether they were interested in collaborating with me in connection with the Revealment study. They were instructed not to inform colleagues who were going to participate in the word association testing later on, about the research design.

Table 3.1 Teacher informant session procedure

The word association testing took up most of the informant session time. Each informant was instructed to work in a Word document prepared by me at the computer. The document contained a two-columns-wide table on each page, with a heading consisting of a stimulus word. Both columns were empty at the outset. The left column was to be used for word associations, whereas the right column was prepared for relationship descriptions (cf. appendix 4-5). The informants were instructed to spend 1 minute producing word associations, writing them down line by line in the left column. Afterwards, the informants spent a maximum of 4 minutes producing relationship descriptions. The informants were prompted to explain the relationship between each pair of words as a descriptive text. They were not to provide a definition, but a description of how one word related to another (cf. discussion below). The alternation between the production of word associations and relationship descriptions gave a one-plus-four-minutes processing rhythm of each stimulus word. I kept track of the time and seconded the informants, and I also provided reminders on file savings during the session.

Concerning the production of response words, the informants were instructed to write down associated words which came into her/his mind when s/he was prompted with a stimulus word. The informants were asked to provide words which s/he found would be relevant to consider when one is about to plan a literature search in connection with the topic expressed by the stimulus word. The teacher informants were allowed to produce as many word associations as they liked, working at word level. In spite of this instruction, some informants found it difficult to produce words as responses and rather produced phrases. Examples will be presented in section 3.3.3. This kind of behaviour was also found with Lykke Nielsen's (2002) informants. Concerning the production of relationship descriptions, the informants were asked to provide a description of the relationship between the stimulus word and the response word, in her/his own words.

The informants were specifically instructed not to provide *definitions* of the response words, but rather try to consider the stimuli and response words and *describe how each pair of words were associated*, according to their own understanding. This is opposed to, e.g., Lykke Nielsen (2002:74) who in a pilot test asked the informants to "write down a short definition of the stimulus word presented after giving associations to the stimulus word". The reason for instructing the teacher informants to provide relationship descriptions, was that I did not want PedNett to be an encyclopedia or a dictionary, but an associative network of pedagogic terminology – in which the emphasis would be on the relationship *between* pairs of words – not definitions with focus on single words. The instruction concerning the relationship descriptions proved to be difficult to grasp, maybe because the notion of such descriptions were so unfamiliar to the informants. When the teachers produced associative data, they tended to think in terms of word definitions (as did the students when using PedNett). There was a considerable variation in how the teacher informants produced relationship descriptions (cf. further discussion in section 3.3.3).

I prepared 13 stimuli words per one hour of informant sessions. The informants were dismissed when the appointed hour was up, whether they had completed processing all the stimuli words or not. During 20 informant session hours, the informants performed 187 processings distributed on 117 unique stimuli words. Most stimuli words were processed only once, some two or more times, with eight processings of the same word at most. In considering how many words should be covered versus how many times each word was to be processed, I had to handle two conflicting considerations; a wish to cover all important topics in the previous examinations, as well as ensuring several processings of recurring topics. The consequences of this aspect of the research design is discussed in sections 3.3.2.2 (choice of stimuli words), 3.3.2.4 (time constraints), and 3.3.6 (considerations on shortcomings). On average, the informants processed between nine and 10 stimuli words per hour. Since each session lasted either one or two hours, this results in an average of 12-13 stimuli words processed during each informant session. I used left-over stimuli words from one session as a part of the set of stimuli words for the next informant.

I did not pilot test the teacher informant sessions. It was difficult to recruit teacher informants, and I decided to determine *after* the first appointed session whether I should consider it as a pilot or not. No methodological changes were necessary, so I considered it as the first ordinary informant session. This informant participated with one hour of word association testing, followed by an informal interview during which I got useful ideas concerning the recruitment of student informants and the integration of the Revealment study into the course of pedagogy.

Before embarking on a word association testing project, there are methodological choices to be done. Lykke Nielsen (2002:74) provides a list of seven considerations which should be made when planning a word association test: 1) choice of respondents, 2) choice of stimuli words, 3) methodology for analysis, 4) time constraints, 5) subjectivity and currency, 6) lack of completeness, and 7) lack of explicit meaning. My considerations and choices on these matters in the research design of the Prearrangement study are laid out in the following sub-sections:

3.3.2.1 Choice of respondents

In the Prearrangement study with the teacher informants, I used criterion sampling. I wanted to collect word associations from topical area experts, and I set up the criterion that the informants should hold a master or PhD degree in either pedagogy or special pedagogy. They were difficult to involve in the study, so I decided to recruit teachers from both the pre-school and general teacher education programmes. I got 12 teacher informants recruited from a population of approximately 60 teachers. I approached the teachers by e-mail and telephone contact, first the head of the section of pedagogy directly, who informed about my need for informants on a meeting. Later I had e-mail-correspondence with each teacher in the recruitment process.

According to Lykke Nielsen (2002), for word associations to be valuable in an information searching context, the associations should be collected from *experts* in a given topical area. The expert requirement concerns the typical situation of word association testing as used in information retrieval experiments, in which the purpose of the associations is to provide vocabulary for others to use (peers or novices). Word associations could however also serve other purposes, e.g., to reveal informants' understanding of a set of stimuli words. The student informants' brainstorming of work task facet terms in the simulated work tasks in the Revealment study might be considered as a variation of this.

The experts' associations will provide a picture of their understanding of a topical area. Associations from novices are expected to be too scattered to be useful for other novices: "[T]he group of respondents must be picked with care to ensure the planned topical focus and approach. Profound subject knowledge and professional experience is needed eliciting response words of high relevance and specificity" (Lykke Nielsen 2002:71). I consider the teacher informants to adhere to the requirement that the informants should be representative for the information environment, in that they represent the approach to pedagogy which the students are supposed to become familiar with during their education. The *novices* in the present study means students who follow the second year course of pedagogy at the teacher education programme – so they are novices as compared to the experts in this setting, though they are not completely ignorant of the topical area in question.

3.3.2.2 Choice of stimuli words

Lykke Nielsen (2002) points out the importance of defining the starting point of a word association testing setup, in finding the source for the selection of stimuli words. In psychological experiments it is common to use existing standard lists. In the present project the stimuli words were selected from two sources; previous examination tasks, as well as words provided by the teacher informants themselves. This catered for a potential benefit of the associative data in connection with a local educational environment.

In an early stage of the planning of the research design, I considered whether I could use a Norwegian thesaurus in the experiment as a resource for stimuli words, as well as in the analysis of the word association data. There has been made two Norwegian thesauri covering the area of pedagogy; *Tesaurus: norsk utgave av europeisk pedagogisk tesaurus* (Nasjonalt læremiddelsenter 1996) and *Norsk pedagogisk tesaurus* (Norsk pedagogisk studiesamling 1978). A large number of the candidates for stimuli words found in the previous examination tasks were not found in any of these thesauri, and they are not in use in any Norwegian library. Accordingly, they are not updated since they were published. The most updated vocabulary of Norwegian terminology in pedagogy is found in *Pedagogisk ordbok* (Bø & Helle 2008), which I have used as a source of reference in handling the data material. This is a dictionary, not a thesaurus expressing the relationships between terms.

In line with recommendations from word association testing in psychology (Deese 1962), all the stimuli words were nouns. The previous examination tasks were provided as a compilation of 30 tasks used in recent years at the same course of pedagogy as the one my informants attended. This set of tasks was used by the teachers in all the eight parallel classes at the general teacher education programme, in the preparation of an examination which the students were going to have a few weeks after the informant sessions. The set of 30 examination tasks were available for the students at an electronic bulletin board. Some students had seen the tasks, others not. Some of the teachers had used the tasks during their lectures. Because of this variation, the first question in the student informant session questionnaire was “Have you seen this examination task before?”, to which the informants could tag out (one or several of) the alternatives ‘No, new to me’, ‘Have seen it (at the bulletin board or as a hand-out during lectures)’, ‘Has been used during lectures’, or ‘Have worked on the task on my own, and I have done the following: ...’.

At the time of the data collection for the Prearrangement study, I had not yet decided which of these tasks to use as simulated work tasks in the Revealment study. I identified all the pedagogic terminology from the examination tasks (including everyday language used as pedagogic terminology, e.g., words like *motivasjon* ‘motivation’ and *lek* ‘play’), according to my own judgement. In the Revealment study, two of the examination tasks were used as simulated work tasks, cf. appendix 15. This procedure is similar to Lykke Nielsen’s (2002:243) experiment, in which the stimuli words were selected from search jobs picked from a log file, whereas “the word association tests were planned before the final search jobs were selected”.

The words from the teacher informants were collected in the following manner: At the beginning of each teacher informant session, before the word association testing, the teacher informants were given the following task: “Put down at least 20 words from the topical area of pedagogy for which the students at the general school teacher education [or: pre-school teacher education, depending on the teacher informant] should become familiar with and should be able to give an account of during an examination”. Some words were provided by several teacher informants in the lists of 20 words.

The stimuli words for the first informant session were all fetched from the pedagogic terminology selected from the set of 30 previous examination tasks. For each subsequent informant, the stimuli words were a mixture of words from the previous examination tasks and the sets of 20 words provided from each teacher informant. These two sources made up an intersection, in the manner that some words were found in both sources, whereas the rest of the words were found in only one of them. Words provided by several informants were ranked as important candidates and used several times as stimuli words. In the selection of stimuli words from the two sources, I used three criteria; frequency of the words provided by the teachers, words found in both sources, and a wish for a general coverage of the topical area. A table of which stimuli words were processed by each informant and which source they were taken from, is found in appendix 6.

3.3.2.3 Methodology for analysis

Before collecting associative data, one should decide whether the resulting word associations are to be analysed manually or automatically. An example of manual processing of the data is found in Lykke Nielsen (2002). She used the word associations as a raw material for a searching thesaurus, in which each pair of stimulus and response word was characterized by classical thesaurus relationships (broader terms, narrower terms, related terms, and synonyms). Algorithmic processing of response words has also been used in information retrieval experiments, based on methods known from psychology involving frequency and strength of overlap between response words.

I chose not to perform any semantic analysis on the word association data in the Prearrangement study before entering the data into PedNett. The rationale for this decision is found in the cognitive linguistic approach used in this project, particularly frame semantics. Frames capture chunks of conceptual knowledge, consisting of elements which are related to each other via all kinds of associative links. These mental networks are individual in each language user. Each unit and each relationship has a unique meaning potential in the mental network, and the conceptual knowledge structure is unique in each individual. Word association testing cannot ‘tap’ all this frame knowledge (cf. section 3.3.2.6), and I wanted to keep the data individual and non-processed – not only the associations, but also the relationships.

Each pair of stimulus and response word in PedNett is considered to have a unique associative relationship, expressed by the relationship descriptions provided by the teacher informants. (The nature of these descriptions will be commented on in section 3.3.3). According to a cognitive linguistic understanding of individual mental networks, meaning potential resides both in the nodes *and* in the relationships making up the web of frame knowledge. As noted in section 2.3.2, this is opposed to a language-internal approach to meaning, in which meaning potential is ascribed to each word, whereas the relationships between words are constants – in thesaural terms with a distinction between conceptual/logical relationships like generic, partitive and instance relationships, which have their formal counterparts in hierarchical relationships.

In choosing to enter the word associations and relationship descriptions in the Prearrangement study into the semantic network PedNett without a semantic analysis of the associative relationships, it should be noted that PedNett was elaborated with a different purpose than e.g., Lykke Nielsen's (2002) searching thesaurus and entry vocabularies intended for use in actual searching. PedNett is intended for use in the prefocus stage, as an idea generator for information need representation and potential search terms. In the Revealment study I investigate how students in the prefocus stage utilize experts' word associations, as presented to them in PedNett. In using PedNett, the students are confronted with a heterogeneous kind of associative data, a matter which will be thoroughly discussed in the analysis in chapter 4.

3.3.2.4 Time constraints

In the experiment I used a free, continuous test in which the stimuli words were presented only once, and then the teacher informants had one minute at their disposal to present a chain of as many response words that they liked, followed by four minutes for relationship descriptions. On the average, the informants produced between four and five word associations and relationship descriptions per stimulus word. An amount of 187 one-plus-four-minutes processings resulted in 803 response words. Pollio (1966) found that in individual, free continuous association testing, the respondents show periods of rapid response rate intermingled with periods of slower response rate. I experienced the same with my informants.

The Prearrangement study was performed before the informants for the Revealment study were recruited, and before the research design for the Revealment study was clarified – including the selection of simulated work tasks. Accordingly I wanted a set of word association data covering most of the central terminology in the topical area of pedagogy, since I did not know which work task facet terms the student informants were to elaborate. Thus, I had to process as stimuli words a large number of potential work task facet terms. Due to the relatively low number of teacher informants, and the fact that they had to produce relationship descriptions in addition to word associations, the total number of stimuli words processing was rather low (cf. 3.3.2 above). At the same time, I needed to cover as much of the topical area of pedagogy as possible. For this reason, a large number of stimuli words were processed by only one informant. This is admittedly a major drawback of the research design of the present study, and the matter will be discussed in section 3.3.6.

A general finding in information retrieval experiments applying word association testing is that the overlap of response words is typically low (Lykke Nielsen 2002). Words of a specific level provide higher overlap than words on a more general level in the topical area. The same source states that an informant can process a maximum of 100 stimuli words during one session, which should last no longer than two hours. In Lykke Nielsen's (2002) experiment, each informant processed 40 stimuli words. They were instructed to provide two responses and spend a maximum of one minute in the processing of each stimulus word.

According to Deese (1965), the frequency of distribution of response words stabilize around the level of 50 respondents, thus requiring 50 processings of each stimulus word used in an experiment if one wants a fair number of recurring response words and not only unique responses. Lykke Nielsen (2002:60) states that "[a] large number of test persons must test the same block of terms in order to obtain a valid result". I understand *valid* in this context to mean useful in an information retrieval context. Considering that the informants should be experts in the topical area in question, there will always be a challenge to recruit enough informants, even in information retrieval experiments collecting only word associations. When – as in the present study – the informants are instructed to provide both word associations *and* relationship descriptions, the challenge is multiplied several times due to the time-consuming data collection process. These conditions make it impossible to use frequency as a variable in the data analysis of this project.

Under ideal circumstances – with stimuli words processed approximately 50 times each – it would have been interesting to study the nature of the response words when it comes to *frequency*, in light of a cognitive view of *entrenchment* (cf. sections 2.1 and 2.3.3) – yet keeping in mind that cognitive entrenchment is related to frequency of use within a *single* person, whereas frequency of response words in a word association test is related to output from *several* persons. Still, response words with high frequency collected from a group of informants, would supposedly be the most entrenched units in the conceptual knowledge of the individual informants. This would again be an indication of central terminology in the topical area.

Though I do not use frequency as a variable in the data analysis, the arrangement of PedNett is inspired by this line of thought, in the manner that the associated words in each *PedNett cluster* are ranked according to decreasing frequency, whereas all the word pairs made only once are displayed in alphabetical order. I use *PedNett cluster* to refer to a PedNett entry term, plus the sum of its associated words and their relationship descriptions. *PedNett cluster* is inspired by Bates (1990) who uses *cluster* to refer to groupings of related words. In her article the clusters appear in the context of an online thesaurus containing a rich entry vocabulary. Despite the low average number of processings of each stimulus word in PedNett, I still got a useful order (i.e. with frequency as the first criterion) for the PedNett clusters covering the work task facets. This is because, in the Revealment study, I selected simulated work tasks related to the stimuli words which had been processed several times. Cf. section 3.3.5 for further characteristics of the semantic network PedNett.

3.3.2.5 Subjectivity and currency: Word associations are individual

Word associations are in their nature ad hoc and *subjective* (cf. this section), *incomplete* (cf. the next section) and *out of context* (cf. the second next section). The informants present what comes into their mind at the spur of the moment when presented with a word out of a usage context. In a searching thesaurus based on stimuli words which are processed by many experts, one might say that the sum of associations provides a shared understanding of the terminology in a topical area, especially if one also looks at frequencies of response words. Conceptual knowledge is highly individual, whereas searching thesauri need to provide a meaning potential for words which are shared by the information searchers within a topical area.

PedNett necessarily contains a large quantity of word associations produced by only one teacher informant, since most of the stimuli words were processed only once (as was discussed in the previous section). Consequently, the individual nature of word associations is more prominent than what is desirable. However, this semantic tool is not intended for query formulation in actual searching and matching with subject headings in databases. Rather, it is intended as an idea generator in the prefocus stage, in the revealment and formulation of information needs as part of students' work tasks – from the vague ideas in a brainstorm, until the formulation of tentative search terms. The relationship descriptions make the data material even more individual in nature. Ideally, each association of stimulus-response word should have been produced and thus 'confirmed' by several informants, and the individual variation of potential meanings would thus be found in the relationship descriptions. With the large number of stimulus-response word pairs occurring only once in PedNett, the individual variation is highly present in the word associations as well as the relationship descriptions.

The two simulated work tasks were chosen because they contain work task facet terms which were processed most often by the teacher informants, with *læring* 'learning' (8 processings) and *motivasjon* 'motivation' (6 processing) as the two top ones when it comes to number of processings. This is illustrated in figure 2.3-2.5 in section 2.3.1.2, plus in appendix 10.

3.3.2.6 Lack of completeness: Word associations are incomplete

Word associations are incomplete, as the associations produced represent only a part of the informants' frame knowledge. This has consequences for the potential areas of application for the associative data – which in this project is in a semantic network used as an idea generator in the prefocus stage of information need formulation. As stated in section 3.3.1.3, a frame cannot be elicited in its entirety. Word associations will never produce complete 'maps' of conceptual frames. Since word associations are individual, one would hardly wish to record complete frames of knowledge. The challenge is to extract the data which might be useful for others – in a retrieval context, or as in this project, in the prefocus stage. Associations which are produced by *several* experts within a topical area will probably be of more use for novices than associations made only once.

3.3.2.7 Lack of explicit meaning: Word associations are out of context

The word association method is based on words *out of context*. With a linguistic starting point – claiming that words only carry a meaning potential in individuals' frame knowledge, and that words only get their meaning when they occur in usage events – this can seem to be a drawback. Lykke Nielsen (2002:117-118) piloted a word association experiment in which the informants were presented with stimuli words *accompanied by a definition*. She found that the informants were very influenced by the input and primarily reproduced words from the definition, rather than producing their own response words. However, for word associations to be useful in an information retrieval context, the experiment should be performed within a restricted topical area. In the present research design, the teacher informants presented associations within the *context* of pedagogic terminology as it was used in the course they were responsible for at the teacher education. This restricted the variation in responses, especially when it comes to words from everyday language used with a topic-specific interpretation in pedagogy.

The word associations performed by the teachers in the Prearrangement study still have the potential drawback of lack of specific usage-based contextual meaning. However, the relationship descriptions are included in the research design and in PedNett as an attempt to overcome the general characteristics of word association data that they lack explicit meaning. The relationship descriptions in PedNett provide instances of usage events and thus provide examples of contextualized meanings. (An example of *contextualized* associations is found in the Revealment study, in which the student informants make a brainstorm in step 2 – based on the work task facet terms and thus contextualized by the simulated work task – cf. section 3.4.2.2. This can be characterized as a kind of word association test (performed by novices), in the *context* of a specific work task. It can be considered as a way to elicit the student informants' present understanding of the topical area.)

If word associations are individual, incomplete and out of context – why then use them in information searching? These are characteristics – not necessarily drawbacks – which one should keep in mind when performing word association experiments. The method is used because it has the advantage of providing first-hand information on experts' understanding of the vocabulary in a topical area. In information retrieval experiments, word associations which are used as raw material for entry vocabularies can be processed manually or automatically before use (cf. section 3.3.2.3), and they can be complemented with other kinds of data (e.g., traditional thesaurus terms). In the present project, the individual character of word associations is seen as an advantage. Word associations provide connections between words based on associative relationships grown out of language users' experiences. Even though word associations are abstracted from contextual usage events, they contain associative relationships, not language-internal symbolic relationships (cf. section 2.3.2).

My application of the associative data can be characterized as a method for identification of language use, with structuring based on relevance connections. I use the associative data to reveal related words, and (in the relationship descriptions) to identify the respondents' understanding of the relationships between words.

3.3.3 Nature of the empirical data in the Prearrangement study

In this section I will describe the nature of the word associations and the relationship descriptions (i.e. the associative data) collected from the teacher informants. Examples of these data were used in figures 2.3-2.5 in section 2.3.1.2 in relation to linguistic expressions of frame knowledge.

The word pair with the highest frequency is *læring* 'learning' – *lek* 'play', as this association is made by five informants; once with *læring* as the stimulus word, and four times with *lek* as the stimulus word. Actually, four out of five processings with *lek* as stimulus word generated the association *lek – læring*, which is very much, considering the general low overlap of stimulus-response co-occurrences found in word association experiments according to Lykke Nielsen (2002). My assumption is that the most central words in the vocabulary of a topical area will yield a higher degree of stimulus-response co-occurrences than the peripheral words. This assumption is not explored further in this project. Which way the association goes is indicated in PedNett in the manner that arrows in front of the relationship descriptions shows which word in a pair appeared as stimulus or response word, respectively (cf. section 3.3.4 below on the elaboration of PedNett).

The stimuli words used in the word association testing were all nouns (e.g., *flerkulturell pedagogikk* 'multicultural pedagogy', *oppvekstvilkår* 'formative environment', *kulturell kompetanse* 'cultural competence'). The stimuli words yielded response words which were also nouns (e.g., responses to *flerkulturell pedagogikk* were *diskriminering* 'discrimination', *etnisitet* 'ethnicity', *flerspråklighet* 'multilingualism', etc.). This was as expected, cf. citation from Deese (1962) in section 3.3.1.1.

The associative data from the Prearrangement study were used as raw material in the elaboration of PedNett. The role of the word associations and relationship descriptions was to give the students access to the teachers' knowledge of the topical area, so that the students via recognition could activate their own conceptual frames. One should keep in mind, though, that "the associations elicited only represent a part of the conceptual map of the individual respondent, since he/she is only allowed to give a limited number of associations. Hence, the conceptual map might not be complete" (Lykke Nielsen 2002:74).

The potential benefits of PedNett as a semantic tool for students in the prefocus stage will be closely related to characteristics of the associative data. The word associations are *subjective* and *individual* in nature, as conceptual frames are individual. The teacher informants produced associations based on their own understanding and application of knowledge in the topical area of pedagogy. These data were entered into PedNett without any semantic (nor frequency) requirements. (This is opposed to e.g., the approach taken in Lykke Nielsen (2002) in which the associative data was used as raw material for enriching an existing thesaurus by new terms, assigned hierarchical thesaurus relationships). The teachers' word associations might – or might not – be relevant for the students' work tasks. However, since the input data for PedNett was not subject to any authority control, I cannot claim that the terms were authoritative.

A well-known phenomenon of word association testing is that a large number of relationships are *unique*, i.e. they are pointed out by only one informant (Lykke Nielsen 2002). In my data material this was obviously the case since most of the stimuli words were processed by only one or two informants. The stimulus word with the highest number of processings was *læring* ‘learning’ (with eight processings). The most frequent response word was *kunnskap* ‘knowledge’ (which was used as response three times). *Lek* ‘play’ had five processings, and had a very strong response association to *læring* ‘learning’ (i.e. four times). Below is a table of the most associated word pairs produced in the ‘direction’ of stimulus word → response word. I also indicate the total number of associations produced from one stimulus word, how many unique responses were produced, and the number of response words produced only once to a given stimulus word. An asterisk behind a response word indicates that the association has also been made in the opposite direction.:

Stimulus word	*Processing times*	*Response word most frequently associated with the stimulus word*	*Word pair couplings*	*Total number of associations produced to stimulus word*	*Number of unique response words associate d to stimulus word*	*Response words produced only once*
læring 'learning'	8	*kunnskap** 'knowledge'	3	41	35	30
motivasjon 'motivation'	6	*læring** 'learning'	3	25	23	22
lek 'play'	5	*læring** 'learning'	4	30	25	22
pedagogikk 'pedagogy'	5	*danning* 'formation'	2	28	27	26
didaktikk 'didactics'	5	4 word pairs made by 2 informants each, e.g., *den didaktiske relasjonsmodellen* 'the didactic relationship model'	2	23	19	15
vurdering 'assessment'	4	*karakterer* 'grades'	3	20	16	13
identitet 'identity'	4	*kjønn* 'gender'	2	17	16	15
danning 'formation'	4	*mål* 'goal'	2	14	13	12

Table 3.2 The most frequent pairings of stimuli and response words performed in the word association testing

We see that the strongest association produced was the stimulus word *lek* 'play' with the response word *læring* 'learning'. We also see that – as expected in word association testing – most word pairs were unique. Some of the stimuli words and response words consisted of typical pedagogic terms which can be found in dictionaries like *Pedagogisk ordbok* (Bø & Helle 2008) and the dictionary *Norsk-engelsk ordbok for grunnopplæringen* (Utdanningsdirektoratet 2011). However, a large amount of the words used in the word association test were common words from everyday language.

Some teacher informants found it hard to produce associations at word level, and provided phases as response 'words' instead, e.g., *tilpasset opplæring som et altoverskyggende prinsipp i den norske skolen* 'adapted education as an all-embracing principle in the Norwegian school'. Lykke Nielsen (2002) describes a similar tendency among her informants. Lykke Nielsen also found in her data a tendency that stimuli words on a general level yield general, scattered associations, whereas more specific words provide a 'tighter' set of associations in the way that the response words were highly related.

My empirical data is far too meagre to state any similar tendency. However, I do note that the general level *pedagogikk* 'pedagogy' produced only unique responses except for one – whereas the more specific words *didaktikk* 'didactics' and *lek* 'play' produced several word pairs provided by two or more informants. As there is no updated Norwegian thesaurus on pedagogy available, I cannot judge whether anyone of the sets of responses are more scattered or rather interrelated. However, it is obvious that most of the response words produced to any of the stimuli words processed by my informants are associative, i.e. *related terms* (RT) in thesaural terminology.

The associative relationships exemplify a variety of sub-types of RTs, e.g., process – activity (*læring* 'learning' – *lek* 'play'), process-result (*læring* 'learning' – *sosialisering* 'socializing'), process – theory (*læring* 'learning' – *læringspsykologi* 'learning psychology'). PedNett contains 803 unique relationship descriptions distributed on more than 700 word pairs. These word pairs mostly contain related terms (RT), rather than *broader terms* (BT) or *narrower terms* (NT). BTs and NTs do occur, however, like *pedagogikk* 'pedagogy' – *spesialpedagogikk* 'special pedagogy' and vice versa. Accordingly, the semantic network PedNett produced from the teachers' word associations, contains a huge set of unique relationships. For a 'lay eye' outside the field of pedagogy, only a few of these word pairs are hierarchical, whereas most of them contain related terms.

After producing word associations, the teacher informants were instructed to describe the relationship between each pair of stimulus and response word, explaining how one word related to another. They were asked to delimit their relationship descriptions with respect to how they contextualized the stimuli and response words in their own teaching. The relationship descriptions provided varied in nature. Two examples of descriptions meeting the requirements, are: *Læring og motivasjon henger sammen ved at motivasjon er en forutsetning for at det skal skje læring* 'Learning and motivation is related in the manner that motivation is a prerequisite for learning to happen' (stimulus word: *motivation* 'motivation', response word: *læring* 'learning'), and *Pisaresultatene lå til grunn for Kunnskapsløftet, mer fokus på kunnskapsutvikling i skolen, bort fra lek og ansvar for egen læring, SVpolitikk* 'The PISA results was a foundation for the Knowledge Promotion reform, with focus on knowledge promotion in school, away from play and responsibility for one's own learning – the politics of the socialist left-wing party' (stimulus word: *Kunnskapsløftet* 'the Knowledge Promotion reform', response word: *pisa* 'Programme for International Student Assessment').

Some teacher informants found the task of producing relationship descriptions difficult, and focused on the *response word* instead of the *relationship between* stimulus and response, e.g., by providing a definition of the response word (e.g., *Utestengning fra fellesskapet* 'Shutting out from the community' made as a relationship description to the response word *diskriminering* 'discrimination', associated to the stimulus word *Flerkulturell pedagogikk* 'multicultural pedagogy'). In the teacher informant session I did not provide any examples of relationship descriptions, since this was part of a free association test. I wanted to explore what kind of data the informants provided from the instructions only, without any influence from modelling examples. (In the Revealment study, I observed that the students were as unfamiliar with using relationship descriptions as the teachers in the Prearrangement study were unfamiliar with producing them. Some students apprehended PedNett as a dictionary, despite the information provided in the informant session questionnaire that PedNett is neither an encyclopedia nor a dictionary, but an associative network intended to provide ideas for pedagogic terminology to be used in organizing work tasks and in the prefocus stage of information searching.)

The nature of the associative data used as raw material for PedNett is strongly influenced by the relatively low number of teacher informants, and the fact that each of them processed few stimuli words as compared to common word association tests, because my informants also produced relationship descriptions. Word association tests typically reveal an extremely varied use of language. This is very true in the present study, as most of the stimuli words are processed only once (for reasons explained above). The nature of the input data in PedNett will be taken into account in the analysis of how the student informants utilize the teachers' word associations, cf. the Revealment study (reported in section 3.4 and chapter 4).

3.3.4 Elaboration of the semantic network PedNett

After each teacher informant session, I edited the text file with respect to spelling errors and consistency (single/plural form, etc.). This is in line with Lykke & Skrubbeltrang (1992) and Lykke Nielsen (2002) in which the form of the response words was standardised linguistically before further use in these projects. Appendix 5 provides an edited version of the word association raw material file provided in appendix 4 (which was described in section 3.3.2).

The associative data was entered into an SQL database called PedNett, made for the purpose of the Revealment study. The database contains 594 words (emerged as stimuli words and/or response words), and 803 word pairs with unique relationship descriptions. I established 36 references either from acronyms to full form of the words (e.g., entering the term *IOP* leads to the PedNett cluster for *individuell opplæringsplan* ‘individual course curriculum’), from one word order to the opposite (*regler og normer* ‘rules and norms’ leads to *normer og regler*), or from ‘unserviceable’ variants (e.g., from *ikke parallellskoler* ‘not parallel schools’ to *parallellskoler* ‘parallel schools’, and from *ulike arbeidsmåter* ‘different manners of working’ to *arbeidsmåter* ‘manners of working’). However, I did not co-ordinate most variations which in an ordinary thesaurus would have been organized as preferred vs. non-preferred terms, as I found that this would be in opposition with the nature of the study, in which I wanted to use un-edited input in the database. We thus find, e.g., both *indre motivasjon* ‘intrinsic motivation’, *ytre motivasjon* ‘extrinsic motivation’, and *indre/ytre motivasjon* ‘intrinsic/extrinsic motivation’, as these variations all occurred as response words.

3.3.5 Characteristics of the semantic network PedNett

The interface of the PedNett database is to be found at http://bibin.hio.no/pednettphd/.[29] The entry page displays the PedNett home entry vocabulary, i.e. the sum of words occurring as stimuli and/or response words (594, of which 117 were used as stimuli words) plus 36 references, a total of 630 terms (cf. appendix 7).

Accessing any of the words at the entry page, one enters a PedNett cluster consisting of the entry term and all stimuli/response words relating to it (cf. appendix 8). By clicking the plus sign ‘+’ below any of these associated words, the relationship descriptions made for the relationship between the given word and the entry term is expanded (cf. appendix 9), whereas clicking the minus sign ‘–’ collapses the relationship descriptions. Right ‘→’ and left ‘←’ arrows indicate the direction of the associative relationship, i.e. → indicates a relationship description between the entry term as stimulus word and the expanded term as response word, whereas ← indicates the opposite. To the extent that the relationship descriptions differ in character, there is a tendency that the descriptions are made with the *response* word as point of departure, possibly using the stimulus word as ‘back curtain’ (cf. 3.3.3). The buttons *utvid alle* ‘expand all’ (and *krymp alle* ‘collapse all’) display (or collapse) the relationship

[29] The PedNett database can (at least until the PhD defence) be entered with the user name ‘phdreader’ and the password ‘pedsearch’.

descriptions for *all* the stimuli/response words relating to the entry term of the PedNett cluster (cf. appendix 10). When clicking on any of the words associated with the entry word, the browser skips to the PedNett cluster for this selected word.

The words associated with the entry word are sorted on *frequency* as the first criterion. This is visualised by the number of arrows and relationship descriptions displayed when a word is expanded. This is best demonstrated by entering some of the words with the highest number of processings, e.g., *læring* ‘learning’, *motivasjon* ‘motivation’, and *lek* ‘play’. The idea of sorting according to frequency, was that word pairs produced by several teacher informants would give an impression of central terms in the topical area (cf. discussion about frequency and entrenchment in sections 2.1 and 2.3.3). Of course this aspect of PedNett is strongly influenced by the fact that most stimuli words were processed only one. The second criterion is alphabetically sorting.

PedNett contains associative data collected from several teacher informants. Looking up an entry in PedNett gives a student access to ‘the spur of the moment associations’ from several persons. These associations are not made within the context of a work task, but rather produced from the teacher informants’ general knowledge in the topical area. As pointed out by Lykke Nielsen 2002:73: “The [word association] method is based on linguistic units out of context. The method does not directly reveal the respondent’s understanding of the stimuli words or the response words. The method is based on individuals’ intuitive and subjective interpretation of the stimuli words, and the identified relationships do not represent an expressed, explicit understanding of the subject domain”.

A PedNett cluster (i.e. an entry term, associated words and relationship descriptions) is by no means a representation of a *frame*, as frames are individual and conceptual. Whereas an ordinary searching thesaurus is intended for the generation of search term candidates as an aid in query formulation, PedNett was made as an idea generator in the *prefocus* information need formulation stage, for the activation of the users’ individual conceptual frames and the recognition of tentative search terms. The potential benefit of both these kinds of tools will be strongly affected by the topical area knowledge and terminological competence of the students using them, as well as by their prior knowledge of the given work task.

3.3.6 Considerations on shortcomings in the design of the Prearrangement study

The outcome of the Prearrangement study was the PedNett database, which was needed as a prerequisite for the performance of the Revealment study. In every word association experiment, there has to be a negotiation between the number of stimuli words used and the number of processings of each stimulus word. In the present study, so many stimuli words were applied that most of them were processed only once. In retrospect, I think that I should have selected fewer stimuli words and accordingly more processings of each word. Ideally, there should also have been more teacher informants. So, in considering the research design of the Prearrangement study, there are especially three shortcomings affecting the reliability and potential practical use of PedNett; first, the number of teacher informants, second, the number of processings of each stimulus word, and third, the inconsistency of the relationship descriptions. I was not ignorant about these matters when the research design was made, but I experienced conflicting considerations.

The number of informants producing associative data was a result of the total number of teachers I managed to recruit; 12 persons doing one or two sessions each. Since they produced both word associations and relationship descriptions, the number of stimuli words processed *per hour* amounted to between nine and 10 words. Since each session lasted either one or two hours, this result in an average of 12-13 stimuli words processed during each informant session, cf. section 3.3.2. The teacher informants processed totally 187 stimuli words, distributed on 117 unique words. The number of stimuli words could have been narrowed down for the benefit of a larger number of processings, but that would have required that the simulated work tasks had been resolved on before the word association data was collected. That was not an option, for reasons discussed in section 3.3.2.4.

The number of processings of each stimulus word is closely related to the number of teacher informants, as well as the need to cover the topical area of pedagogy. At the time of the data collection for the Prearrangement study, I had not yet decided which examination tasks to use as simulated work tasks in the Revealment study. The collaboration with the teachers from whose classes I were to recruit student informants, was not established by that time. Neither was the research design for the student informants' session. Accordingly, I felt the need to cover the main topics of pedagogic terminology in general.

A major drawback with the low number of processings of each stimulus word, is that I could not make frequency effects an issue. With several processings of all stimuli words – and preferably the same number of processings of each – I could e.g., have made a cut-off value, stating e.g., that only word pairs produced by at least two teacher informants would be entered into PedNett. The pros and cons of the distribution on different stimuli words versus the number of processings of each word is a matter of area of coverage in the topical area of pedagogy, and the density of associations. PedNett is just a pilot version of a semantic tool, to be used in an experimental setting. I will discuss in chapter 5 which changes I would recommend to make if one were to make such a semantic tool for a real-life purpose.

The inconsistency of the relationship descriptions was discussed in section 3.3.3. Influenced by Spiteri's (2005) experience that informants can be very influenced by exemplifying instructions (and rather 'copy' elements from the examples), I chose not to provide modelling examples of relationship descriptions. The drawback was that the relationship descriptions are of such a various nature that it was confusing for the student informants. A pilot testing of the teacher informant sessions could have led me to another conclusion with respect to this matter, but due to the low number of teacher informants I did not pilot the Prearrangement research design (cf. 3.3.2), as opposed to the Revealment study, in which I made a pilot with three student informants.

3.3.7 Summary of the Prearrangement study

In section 3.3 I have presented the word association method as it originated in psychology, and how it has been used in the field of information searching. I have presented the methodological choices which I have made in planning the word association test and collecting the data in the present study, according to Lykke Nielsen's (2002:74) list of considerations. Furthermore, I have described the nature of the associative data and how this was used in the elaboration of a semantic network. The resulting PedNett database was also characterized. Finally, I have discussed the shortcomings of the research design of the Prearrangement study.

3.4 Revealment: The users. Students' prefocus information need formulation

The Revealment study concerns the exploration of the student informants' information need formulation in the prefocus stage. Whereas the elaboration of PedNett in the Prearrangement study was carried out just as a prerequisite for the study of the user revealment process (cf. section 3.3), the Revealment study made up the actual investigation of my three research questions. First, I needed to collect empirical data on students' elaboration of work tasks and formulation of information needs in the prefocus stage. Second, I wanted to know how students in the prefocus stage utilize teachers' frame knowledge expressed as word associations and relationship descriptions. Third, I needed information on how differences in learning style relate to differences in use and evaluation of PedNett. The Revealment study consists of a pre-session data collection and a one hour laboratory-like session performed in groups in computer classrooms on three following days.

I used a combination of criterion sampling and maximum variation sampling in the Revealment study. I wanted novices in the topical area of pedagogy, and I defined novices as second year educational science students at OAUC/Edu. They were novices as compared with their teachers, but not in the interpretation ‘no knowledge’ in the topical area. My use of *novices* (second year students at a course in pedagogy) and *experts* (teachers at the course in pedagogy) thus differs from the definitions used in Sihvonen & Vakkari (2004a, 2004b), in which *experts* are defined as undergraduates in pedagogy, whereas *novices* had conducted no studies in this field.

Because I wanted to get data on the variation and complexity among this category of students, I recruited three full classes of students, counting 55 informants. I use a sample of n=54 because one of these was rejected in the analysis due to technical and methodological reasons. One student with an African language as mother tongue was excluded from the original sample of 55 informants. She had misunderstood the work task due to little fluency of Norwegian. Also, she had technical problems which entailed that she had only just started with the second part of the informant session when the other informants had completed their sessions, so she used two hours instead of a maximum of one hour. In the rest of the thesis I will use *sample* in referring to n=54.

At OAUC/Edu there are eight parallel classes counting 25-30 registered students in each group. Three of the teachers who participated in the Prearrangement study were willing to include the informant sessions as a part of their lecture programme. Students from classes supervised by these teachers participated in the Revealment study, counting nine, 19 and 26 students in each group, respectively. The number of students participating in the lecture programme varied from class to class. However, from each group, practically all the students present on the day of the informant sessions joined the test.

In association with the pilot testing of the Revealment study (cf. section 3.4), I experienced that it was difficult to recruit students as informants when the session was not a part of their ordinary time schedule. In the main study I would not risk a bias towards one kind of student, e.g., the ‘eager, motivated, high-achieving students with a strategic learning style’. Conducting the data collection as part of the students’ ordinary lecture program ensured the sample both when it comes to the number of, and variation among the informants. Sampling should be judged in context. Though the research design of logging the prefocus stage required a laboratory setting, I aimed at making this setting as real-life as possible. Thus, the informant sessions took place in the students' ordinary learning environment, as the mid-session of three lectures of pedagogy, and they worked in their customary computer room.

The only characteristics making each class non-representative of the category of general school teacher education students, is that they all have fluency in Norwegian. Students with Norwegian as a foreign language attend a class for students who are going to give teaching in mother tongue reading and writing for children who have Norwegian as their second language. This was a desirable bias for me, for reasons presented in section 3.2.4.

In section 3.4 I will first give a presentation of the two theories of method which I applied in the Revealment study; first, the application of simulated work tasks, and second, the ASSIST learning style test. I will go on to present how the empirical data was collected from a pre-session questionnaire, a main session questionnaire, and by logging of PedNett use during the main session. This will be followed by a presentation of the data analysis method, and considerations on shortcomings in the research design of the Revealment study, before I summarize the presentation of the Revealment study.

3.4.1 Theory of method in the Revealment study

I chose to use simulated work tasks to be able to explore the first two research questions on students' elaboration of work tasks and formulation of information needs in the prefocus stage. Furthermore, I selected the ASSIST learning style test to be able to explore my third research question on how differences in learning style relate to differences in use and evaluation of PedNett. For my second research question on how students utilize teachers' associative data, I also applied the word association method in the compilation of PedNett; cf. the Prearrangement study described in 3.3.

3.4.1.1 Simulated work tasks

The prefocus stage of the information searching part of a work task is not a situation which is naturally logged – at least not in a similar way as search logs can be used to study information searching behaviour. I have used *simulated work task situations* inspired by Borlund (2000, 2003) to be able to capture the user revealment process of students.

> A simulated work task situation is a short 'cover story' which describes a situation that may lead to IR[30] and seeking. The 'cover story' is a semantically rather open description of the scenario and context of a given simulated work task situation. (Borlund 2000:80)

These realistic scenarios were used by Borlund to serve the functions of *realism* and *control*, i.e. to trigger the development of an information need and a subsequent search situation, and to establish a platform against which situational relevance could be judged. I used simulated work tasks to trigger an information need to be able to study the *prefocus stage* of information need elaboration, with a combination of realism – in aiming at making the test situation as *real-life* as possible – and control – in letting the students elaborate a *defined* set of terminological steps. I needed to make explicit a process which is usually tacit in the user, for me to be able to study the cognitive and terminological starting point of students handling information-based work tasks.

Based on Ingwersen's (1996) cognitive communication models, Borlund considers an information need as a consequence of a *problematic situation* – an *anomalous state of knowledge* in which an information need has to be met (Belkin, Oddy & Brooks 1982a). Simulated work tasks are useful to trigger informants in a laboratory setting with information needs when one wants to collect information on their information need elaboration behaviour.

Borlund applies the work task concept described by Byström & Järvelin (1995). They divide work task complexity into five categories according to the pre-determinability of the information requirement of the given work task. These five categories are: Automatic information processing tasks, normal information-processing tasks, normal decision tasks, known, genuine decision tasks, and genuine decision tasks. I consider the simulated work tasks used in the present study to exemplify *genuine decision tasks*. These are characterized by being unstructured, and without predefined information requirements – so task structuring and clarification of information need will be major concerns for the student informants.

We will have to keep in mind the difference between *work tasks* versus *search tasks*. Byström (2002), Byström & Hansen (2005) and Byström & Järvelin (1995) divide task performance into three main parts, i.e. task construction, task performance, and task completion. *Task performance* – Byström & Hansen's (2005) first part – corresponds to Kuhlthau's (2004) stage 1-4 (i.e. task initiation, topic selection, prefocus exploration, and focus formulation), whereas *task performance* corresponds to Kuhlthau's stage 5 (i.e. information collection), and *task completion* corresponds to Kuhlthau's stage 6 (i.e. search closure).

[30] IR = information retrieval.

A work task contains a search task as one of several sub-parts – so a search task is embedded in a work task. The simulated work tasks used in the present study are made up of previous examination tasks. The students are 'forced' into having an information need due to an assigned work task, and consequently they have to structure the task and formulate each their own information need and tentative search terms. So I use a more general context than e.g., Lykke, Price & Delcambre (2012), in which the informants are assigned *search* tasks containing a topic description followed by a specific search instruction starting with "Find documents that help you to decide ...". In the research design I have tried to collect information on the cognitive process prior to a presupposed search situation. This is done in 8 terminological steps[31] which will be presented in section 3.4.2.2.

3.4.1.2 Learning style: The ASSIST test

A learning style can be understood as the conscious or unconscious ways students learn something new – how they concentrate, and the various ways they elaborate, acquire and remember new information. "Approaches to learning refer to individual differences in intentions and motives when facing a learning situation, and the utilisation of corresponding strategies" (Diseth & Martinsen 2003:195). No learning style is considered better than another learning style per se – however, the idea is to adapt teaching strategies corresponding to the students' different learning styles – or for students to be aware of their own learning style as a part of their study technique. I wanted to test my informants for learning style to explore whether differences in learning style also have an impact on their information need formulation behaviour. In turn, this knowledge would be useful in adapting searching tools to students' various challenges in information need formulation, as well as in information literacy training.

I chose to use a Norwegian abridged version of the *Approaches and Study Skills Inventory for Students* (ASSIST), a learning style test translated and validated by Diseth (2001).[32] The ASSIST test is one of several tests used in pedagogy and psychology to characterize students' learning styles. The variables used in ASSIST are called the *deep*, *surface,* and *strategic* learning styles. A student with a *deep* approach to learning is motivated by an interest in a given topical area and vocational relevance, and has an intention of acquiring a thorough understanding of the learning material. A student with a *surface*

[31] All references to terminological steps are written as ciphers in this thesis.
[32] An English abridged version was used by Heinström (2002) in her study on personality and information seeking behaviour.

approach, in contrast, has a predominant motivation of fear of failure and is concerned with the completion of a course. S/he is preoccupied with an intention of reproducing rather than understanding. The third approach, the *strategic* learning style, is associated with the intention of achieving the best results possible.

The *deep* approach is associated with the learning strategies ‘use of evidence’ and ‘relating of ideas’, whereas the *surface* approach is associated with ‘rote learning’. The *strategic* learning style is not associated with a specific learning strategy, but utilizes whatever strategy serving the purpose of achieving success (Diseth 2001). We should note that a student’s learning style is not constant, and may change during several years of study due to, e.g., personal experience and improved study skills.

When using the ASSIST test, the informants necessarily get a score on all of the three learning styles, as they assign a value from 1 to 5 for each question on (5=agree, 4=partly agree, 3=uncertain, 2=partly disagree, 1=disagree). Since I apply an abbreviated Norwegian version of the ASSIST test with 24 questions (8 questions related to each learning style), each informant necessarily will get a score between a minimum of 8 and a maximum of 40 for each style. I will define scores from 33 to a maximum of 40 as *high* (i.e. a mean score above 4 on the 5-point scale), scores from 29 to 32 as *middle* (mean score above 3,5 and up to 4), and scores under 29 (up to 3,5) as *low* score on a given learning style.

Using these cut-off points, divides the informants in three groups about the same size. However, as we will see in the analysis of the ASSIST data in section 4.3.1, I will focus on a continuum of *degree of deep learning style*, since this variable relates to other variables in the analysis (e.g., number of terms in the terminological steps). Aaron & Skakun (1999) state that in statistical analyses of ASSIST test data, one typically finds a positive correlation between *deep* and *strategic* learning styles, and negative correlations between deep and surface, as well as strategic and surface learning styles. Thus, I had an expectation that some students would have a score of at least 33 on more than one learning style, probably deep and strategic.

3.4.2 Data collection method

The raw material of the Revealment study is made up by the questionnaire used in the pre-session (cf. 3.4.2.1), a main session questionnaire containing the work task assignment and the 8 terminological steps (3.4.2.2), and an end-of-session questionnaire (3.4.2.3), plus logs of the registered PedNett use during the main session (3.4.2.4). The pre-session questionnaire was distributed to the student informants when they were recruited. The Revealment study was pilot tested with three student informants. This resulted in minor adjustments of the main session questionnaire. The nature of the empirical data (e.g., whether I collected check-off alternatives or free fill-in text) will be described along with the data collection procedure in this section, whereas the analysis of the data belongs in chapter 4. The students were paid a fee of 150 Norwegian crowns for their participation as informants, in the form of a voucher for the campus bookstore.

3.4.2.1 Information collected before the 8 terminological steps

When the students arrived for the computer laboratory sessions, they delivered a filled-in pre-session questionnaire with demographic information, some information behaviour related questions, a learning style test, and a consent form for the participation in the project. The questionnaire had been distributed two weeks before, when I recruited student informants in the beginning of a classroom session. This section deals with the pre-session questionnaire, plus the first question of the main questionnaire (in which the informants were assigned a simulated work task assignment). Together this information made up the background information I had about the students before they embarked on the 8-step information need formulation. The pre-session questionnaire is reproduced as appendix 11 and translated in appendix 12, whereas the work task assignment is found in the main questionnaire, which is reproduced as appendix 13 and translated in appendix 14. Except from the filling in of demographic information, the information was collected by check-off alternatives related to previous studies in pedagogy, searching experience, terminological challenges, and (in the beginning of the main questionnaire) prior knowledge of the assigned task. The ASSIST test (cf. 3.4.1.2) employs a 5-point Likert scale. The analysis of the empirical data collected in the pre-session questionnaire is provided in section 4.3.

3.4.2.2 The 8 terminological steps: The main part of the informant sessions

In the one hour main session the informants elaborated the information need caused by the assigned work task in 8 terminological steps, working with pen and paper in a 15 pages questionnaire (cf. appendices 13-14). This main questionnaire consisted of two parts.; first, pages 1-9 concerning the 8 terminological steps (cf. this sub-section), and second, pages 10-15 containing an end-of-session questionnaire (cf. the next sub-section). The students were instructed to spend 45-60 minutes on the whole session – with approximately 10 minutes on organizing the work task and arriving at tentative search terms (equals steps 1-5), 20 minutes on PedNett use and revisions of their own work task structure, information need and tentative search terms (steps 6-8), and 10 minutes for the end-of-session questionnaire. The expression *terminological steps* was not used in the instructions. The students were notified after 10 minutes that they should start using PedNett (cf. p. 7 in the main questionnaire). They were also reminded after 45 minutes that they had at most 15 minutes left, and should start on the end-of-session questionnaire if they had not done so yet.

Two different simulated work tasks were used, presented in appendix 15 and translated in appendix 16. The work tasks were selected from a set of 30 examination tasks previously used for written exams at the course in pedagogy from which the student informants were recruited. I will refer to the two tasks applied in the study as the *Comprehensive school task* and the *Motivation task*. 28 students worked on the first of these tasks (i.e. the two first classes, with 9 and 19 students), whereas 26 students worked on the second task. The Comprehensive school task had 6 work task facets, whereas the Motivation task had 5 facets, cf. translation of the simulated work tasks in appendix 16.

In designing the 8 terminological steps I wanted to explore both the *process* and the *result* of the informants' clarification of their information need in the prefocus stage. Terminological steps 1-5 was conducted without any semantic input (and the informants worked with pen and paper), whereas in steps 6-8 the informants used PedNett via a browser to get semantic input, when they revised their terminological choices. Their movements in PedNett were logged and registered in a database (cf. section 3.4.2.4). In the last part of the session the informants filled out an end-of-session questionnaire, which was included as the last six pages of the main questionnaire.

The 8 terminological steps of the Revealment study involve the elaboration of an information need in a simulated work task context. The assignment of the simulated work task preceded these steps. The steps are provided with the following names for ease of reference: *selection* (step 1), *brainstorming* (2), *structuring* (3), *clarification* (4), *formulation* (5), *structure revision* (6), *clarification revision* (7), and *formulation revision* (8). We see that the terminological activities called structuring, clarification, and formulation are performed twice, first without any semantic input (called steps 3-5), and then the same steps with the semantic input from PedNett (called steps 6-8). I have as an assumption that an important factor which would influence how the student informants utilize and benefit from the input from PedNett, is how far they have come in the process of gaining terminological competence in the topical area of pedagogy. The last step represents the end result in the context of this research design; i.e. the set of reformulated tentative search terms. I have deliberately chosen to elaborate my own set of labels to refer to the 8 terminological steps. These steps model the prefocus stage of information searching embedded in a work task, the way I conceive of it. Other models concern either the whole information search process – e.g., like Kuhlthau's (2004) six stages – or they provide specific search tactics (e.g., Bates 1979 and Vakkari 2000).

In *step 1* the informants were instructed to encircle what they conceived of as the work task facet terms. In *step 2* they were asked to perform a two-minute unstructured brainstorm of topics that they would want to include in an assignment. In *step 3* they were asked to structure the brainstorm according to the work task facet terms selected in the first step. *Step 4* was aimed at a clarification of the information need, in that the informants were asked for which topics (from the structured brainstorm) that they would need to find more information to be able to proceed with the work task. This resembles a formalized need in Taylor's (1968) terminology, whereas *step 5* resembles Taylor's compromised need, i.e. the formulation of a query – consisting of search terms – as presented to the information system. Only, for my informants, it cannot be called a query formulation, but rather a *tentative query*. The informants were asked to write down exactly how they would formulate a search, with terms, and – if desired – operators/signs. Since most of the students entered only words and no operators in the questionnaire, I will refer to these as *tentative search terms*. Taylor (1968) was presented in section 1.2.3.

In steps 6-8 the informants were instructed to enter PedNett, and to consider revisions of steps 3-5 (on the same pages in the questionnaire), based on input from the associative data in the database. They were to consider revisions in the structured brainstorm (*step 6*), revise the information need clarification (*step 7*), and revise the formulation of tentative search terms (*step 8*). The informants were instructed to use a red ink pen in steps 6-8, for me to be able to differentiate between data added in steps 3-5 (with blue ink) versus steps 6-8.

The rationale for the creation of PedNett was to explore how students in the prefocus stage might utilize and possibly benefit from their teachers' understanding of the topical area of pedagogy, provided as a semantic network of word associations and relationship descriptions. Novices in a topical area can experience both the situation of knowing a topic-specific word without understanding its specific conceptual content, and the opposite situation – to have a conceptual content in mind without being able to find the proper word label for it. The intention behind PedNett is to provide a semantic help for students who face this kind of terminological challenges when they express their information needs in the prefocus stage and prepare tentative search terms.

Working on the terminological steps served two purposes: For the students, it was a trigger for the activating and enriching of their conceptual frames, which made them better prepared for an eventual search session. My primary purpose, however, was to have a way to collect data to get a better understanding of the students' conceptual point of departure in the prefocus stage – including work task elaboration, information need expression and the formulation of tentative search terms.

An example of the 8 terminological steps performed by one informant is provided in appendix 18 (as a scan of pp. 2-6 in the main questionnaire). Appendix 19 demonstrates how these data were later registered by me in the empirical database. The empirical database will be further described in section 3.4.3 concerning the data analysis method. The analysis of the empirical data collected during the 8 terminological steps of the informant sessions, is provided in sections 4.4-4.10.

3.4.2.3 End-of-session part of main questionnaire

The students spent approximately 10 minutes on the end-of-session questionnaire, containing questions concerning the students' work task habits, and challenges with respect to work tasks and information searching in general (cf. pp. 10-15 of the main session questionnaire, reproduced as appendix 13 and translated in appendix 14). They were also asked about their experiences and evaluation of PedNett use during the informant session. The work task-related questions dealt with challenges concerning how to pin-point work task facets, thinking of topics related to the work task facets, structuring the work task, etc. The search-task related questions dealt with challenges concerning how to clarify an information need, decide which databases to use, make quality judgements, etc. The informants were asked to indicate perceived obstacles on a continuum from 'easy' to 'difficult' by checking off on a double-ended arrow for each question. The questions related to work task habits, as well as the PedNett evaluation, had either check-off alternatives or spaces for filling in of free answers. The analysis of the empirical data collected from the end-of-session questionnaire is provided in section 4.11.

3.4.2.4 Logging of PedNett use during the student informants' sessions

The informants got instructions about how to enter the PedNett database on p. 7 of the main questionnaire. This included logging on, entering a PedNett cluster, expanding/collapsing relationship descriptions to the word associations, and skipping between PedNett clusters. There was also an explanation about the arrows indicating the direction of the relationships.

Each informant's movements in PedNett were logged and registered in a database. This was for me to be able to check which associative data the students had been confronted with as compared to what they used as input in revising steps 6-8 of the questionnaire. For instance, I wanted to know to what extent they visited only PedNett clusters containing work task facet terms, or whether they also visited nodes several 'clicks' away from what they used as entry terms. Appendix 17 provides an example of a log of actions performed in PedNett during an informant session. The logs of PedNett use are used as a part of the analysis of the informant sessions (cf. sections 4.4-4.10). I will provide some characteristics of typical PedNett use according to the logs in section 4.4.3.

3.4.3 Data analysis method

In section 3.1.1 I established five guidelines for my empirical study, using case-studies and a predominantly qualitative approach. As stated there, my aim is primarily to describe and understand the object of study, i.e. prefocus information need formulation – not to find causal or general explications. I wanted to collect concrete, contextual knowledge, and to include complexities and contradictions, just as in real life. The empirical data collected in the Revealment study was very complex, containing 2 hand-written questionnaires plus a PedNett log from each of the 54 student informants. I chose to establish an empirical database (in an SQL structure) to be able to consider single variables across the informant population. The descriptive analysis was performed by abstracting data from single tables or fields from the database.

3.4.3.1 Construction of a database for registration and coding of the empirical data

The data in the pre-session and main session questionnaires was entered into an SQL database made for this purpose, henceforth referred to as the empirical database. Appendix 20 provides an overview of database tables and fields used. This database, together with the database containing the logs of PedNett use (cf. example in appendix 17), made up the data material which was subject to the analysis presented in chapter 4.

Questions with check-off alternatives were established as categories with a set of possible variables. The main challenge in registering the empirical data, was the free-text hand-written data filled in by the students in the 8 terminological steps. To be able to search the data predictably, I corrected spelling errors and used standard Norwegian. During the registration process, I entered my first-impressions of the informants' formulation behaviour into fields provided for this purpose in the empirical database. An example of the 8 terminological steps performed by one informant is provided in appendix 18. This contains the filled-in pages from the 8 steps of the main questionnaire. Appendix 19 shows how these data were registered in the empirical database.

3.4.3.2 Descriptive and analytic approaches used in the data analysis

During the registration of pre-session and main session questionnaires, I got a good grip of the empirical data, both when it comes to the complexity as well as some main tendencies. In the subsequent analysis, I made abstracts of the database (as spreadsheets) for single tables or specific variables. Especially important was the textual fields of the 8 terminological steps. These were subject to an in-depth analysis of each informant, as well as each field across the informants. I went through a laborious back-and-forth process between the empirical data and the sets of categories which I established – e.g., the categories of *PedNett user types* and *formulation behaviour* in the prefocus stage presented in the analysis of chapter 4. The analysis was 'hands-on', in the sense that I focused on descriptions rather than calculations (I did no calculations apart from percentages). I often checked my findings from the in-depth-analysis based on abstracts from the empirical database, with a meta-perspective by looking through the hand-written questionnaires, as well as my first impressions as I had logged them in the empirical database.

3.4.4 Considerations on shortcomings in the design of the Revealment study

In this section I will make some reflections on the choices I have made in using simulated work tasks and the ASSIST learning style test in the research design. I will also comment on the choice of the two work tasks.

The first reflection concerns the use of *simulated work task* in the data collection procedure. Ideally, data collection on information searching behaviour should log the users' elaboration of genuine information needs in a real-life setting, not forced-upon information needs in a laboratory setting. Markey (2007:1128) is sceptical to simulated work task experiments: "[L]et us avoid research protocols that assign tasks to end users. As much as possible, researchers should design experiments that capture what end users really do, not what researchers want or expect them to do". However, some kinds of data collection are impossible to arrange without some sort of assigned information needs or arranged setups. One example is Toms, Villa & McCay-Peet (2013), who used simulated work tasks in a laboratory setting to acquire comparable empirical data concerning the efforts spent on information searching in relation to the overall task activity. Another example is White & Iivonen (2002) who studied students' assessed levels of difficulty in Web search questions prior to searching, i.e. without involving actual system usage.

In the data collection of the present project, I had to assure that the work task facet terms would be found in PedNett, and that several students would be elaborating on the same information needs. The aim was to make an experimental situation which was as close as possible to a real-life setting. The informants were assigned simulated work tasks which had been used previously at the same course (with other students). They worked in writing, simulating the situation they were used to in working on written assignments at their studies. They had the same amount of time available each, like in an examination situation. Moreover, for students there is a fuzzy border between genuine and assigned information needs. The one moment they have no information need, and the next they have an information need in association with an assigned task as part of their studies. It is common for students to be provided with a general topic description for which they are supposed to arrive at a self-selected focus with an individual approach. This is a situation in which they get an information need which they have to handle as a part of their work task.

The second consideration I want to reflect on, concerns my application of the *ASSIST learning style test*. As my methodological approach is predominantly qualitative, I have applied the ASSIST test in a somewhat unorthodox manner. I wanted to have a learning style score for each student as a point of departure in the analysis of the informant sessions. As my third research question indicates, my aim is to explore how differences in use and evaluation of PedNett relate to differences in the students' learning style. So I will need to characterize the learning style of each informant, and then find out whether there are any relationships between a given learning style and characteristics concerning PedNett use – e.g., the 'willingness' to add PedNett terms to the original set of tentative search terms.

The ASSIST test is typically used in quantitative studies with hundreds or even thousands of informants. In statistical analyses one typically calculates the informants' mean scores for the three learning styles. In Heinström's (2002), with informants from the Faculty of Education at Åbo Akademi, the mean scores for all the informants were 70 % of the total possible score on the deep learning style, 50 % for surface, and 63 % for the strategic learning style. (I have transferred the mean score values in table 10 in Heinström (2002:133) from points to percentages). There were some differences between informants from different faculties. Thus, the mean scores for the informants from the Faculty of Education at Åbo Akademi, were the same for deep (70 %) and surface (50 %) as in the total informant population, but 70 % for the strategic learning style. It differs from study to study whether the deep or the strategic approach has the highest mean value. In Diseth (2001, 2002, 2003) and Diseth & Martinsen (2003) the strategic learning style has the highest mean score, whereas in Aaron & Skakun (1999) the deep approach has the highest score. In statistical analyses, one seeks to find correlations between learning styles and other characteristics – e.g., the informants' searching style, as in Heinström (2002).

A third matter I considered in making the research design, was whether I would use *one* or *several different tasks* for the simulated work tasks. I chose to use *two* different tasks, which I named the Comprehensive school task (assigned to 28 students) and the Motivation task (26 students). I wanted to use more than one work task because I wanted to be able to compare the kind of variation in PedNett use caused by different tasks. On the other hand, I confined myself to two (rather than three or even more tasks), because I preferred the work tasks facet terms to be represented as clusters in PedNett. This was the case for the Motivation task and to a certain extent for the Comprehensive school task. The other tasks in the set of 30 examination tasks which were used as simulated work task candidates, however, were too poorly covered in PedNett.

I have not made any significance test calculations on the empirical data. In choosing to use two different simulated work tasks, I made it even less relevant to perform any testing of statistical significance, since each group of students counted less than 30, which is commonly considered to be a requirement for such tests. However, I do not see this as a drawback. The research design is accommodated for qualitative analysis with a focus on individual variation and the establishment of categories of users' formulation behaviour, based on descriptions of examples. I do not aim at postulating hypotheses or measuring effects.

If I wanted to perform significance testing, I should have postulated a hypothesis and established a significance level before I even collected the data. Because of this, I will not make any post-hoc significance testing on interesting findings in the analysis, however tempting it might be to emphasize a result by claiming that it is significant. In the analysis I will describe how different variables relate to each other and point out what I will call *emerging patterns* in the empirical data.

I will be cautious in drawing conclusions from characteristics found in the smallest categories, keeping in mind Kahneman's (2011) *law of small numbers* concerning how extreme results are more likely in small data sets. Kahneman (2011:109-111) provides an example with a study of incidences of kidney cancer showing that rural, sparsely populated counties had the lowest rate. It is easy to infer from this that these extreme results (low cancer rates) were directly due to a rural lifestyle. Kahneman however shows that the key factor is that rural counties have small populations, and that it is a statistical fact that extreme results are more likely in small data sets. I will not claim that my findings are predicative for users' formulation behaviour in general, but restrict myself to patterns found in the collected data. I want to let the analysis conclude in tentative assumptions which can be used as a point of departure for future research.

3.4.5 Summary of the Revealment study

In section 3.4 I have laid out the research design for the Revealment study, in which I collected empirical data on students' prefocus information need formulation. I started by presenting the theoretical rationale behind the use of simulated work tasks, as well as learning style testing. This was followed by a description of the procedure for the data collection, which resulted in a pre-session questionnaire, a main session questionnaire, and a log of PedNett use for each of the 54 student informants. Furthermore, I have accounted for my descriptive and analytical approach, as well as the construction of an empirical database to cater for the comparison of variables across the informant population. Finally, I have discussed the shortcomings of the research design of the Revealment study.

3.5 Integration of theoretical framework and empirical study

In this section I will comment on how the theoretical framework which I presented in chapter 2, has been applied in the empirical study – especially the concepts of *frame semantics* and *spreading activation*. I have used the frame semantic approach to the understanding of users' information need formulation, described as a process of enriching cognitive frames. The phenomenon of spreading activation is triggered in both the Prearrangement study and the Revealment study. These perspectives have motivated the research design, and will also form the basis of the analysis of the empirical data.

Frame semantics was introduced in section 2.3.1 as a part of the cognitive linguistic framework. We saw that according to frame semantics, the meanings of words are made up by their relationships to frame knowledge. Knowledge about *words* is boundlessly integrated with knowledge about the *world*. Words are understood by their association to essential knowledge that relates to that word, called the set of frames in which it plays a role. In section 2.4.1 I used the frame semantic perspective in a layout of the acquisition of terminological competence. In chapter 3 I have tried to integrate this approach in the research design for the empirical study.

Students elaborating their information needs when working on an assignment face the contradictory situation of having to formulate what they do not know. With this point of departure, I have made a research design for a study in which I explore whether – or how – experts' knowledge of terminology (and all sorts of connections between knowledge elements) could be a help for novices. I have asked myself how students might benefit from teachers' frame knowledge, and whether it would be a help for them to be presented with a network of pedagogic terminology and descriptions of how the elements are interrelated. This gave rise to the idea of establishing PedNett. We have stated that frames are entities of *conceptual* knowledge, so it would be wrong to say that PedNett contains the teacher's frames. However, PedNett contains a network of *linguistic expressions* (i.e. word associations and relationship descriptions) originated from the teachers frames.

Word associations are produced outside an ordinary language use situation. Earlier in this chapter I have discussed whether there is a contradiction between the teachers' word associations produced out of context of a work task, and the students' information needs expressed in a work task context. As already noted, word associations represent only a part of an informants' frame knowledge. Still, I think experts' understanding of the terminology and interrelations in a topical area can be very useful for novices. Although the teachers' word associations are produced out of context of 'real information needs', they are still produced in the context of the teachers' frame knowledge in the topical area of pedagogy. This gave rise to my assumption that students might benefit from the teachers' frame knowledge expressed as associative data.

The psychological factors involved in the information need formulation process were discussed as a part of the theoretical framework, including the theory of *spreading activation* (cf. section 2.5.3), and the *winner-takes-all* mechanism (2.5.4.1). Spreading activation was described as a cognitive process in which activation of nodes in the mental network spreads onward from one node to another via associative links. The winner-takes-all mechanism was introduced as a process in which a stronger node inhibits weaker ones. This gave an expectation that once a word has been selected to express a topical facet, the next work associated will probably *not* be a synonym, as the activation of neighbouring words has been weakened. In my empirical data I can see examples of the winner-takes-all mechanism in that both the teachers producing word associations and the students performing a brainstorming task produce associative relationships rather than synonyms. In the remainder of this section I will concentrate on spreading activation.

The spreading activation process is prompted in both parts of the data collection in the present project. In the Prearrangement study (with the elaboration of the semantic network PedNett), the teacher informants made word association testing. Each stimulus word activated the informants' network of related words in their mental lexicon. These related words were expressed as response words, in the order each of the words came into the informants' mind. Experts were used in this word association testing, because their associations in the topical area of pedagogy would be richer and more entrenched. The factors imposing which response words would be provided first, is related to recency and frequency of use: "Some associative links, thanks to recent or frequent use, are particularly effective" (Reisberg 2001:238). That is to say that the most entrenched stimulus-response word pair connections will pop up first. The reason why it is more relevant to collect word associations from topical experts than from novices, is thus that their daily processing of knowledge in the topical area will result in the effects of recency and frequency of use which again will make them produce strongly topic-related associations.

The student informants went through a similar process in step 2 of the Revealment study. In the brainstorm task the students were asked to associate topics which they found relevant to include in a paper, just writing down the words continuously as they came into their mind. This task was made to prompt the activation of the informants' mental network related to the work task facet terms, and to make the students elaborate their information needs in a stepwise manner, not just 'skipping' from reading the assignment text onto expressing tentative search terms.

I have stated the assumption that PedNett use can prompt the recognition of relevant words which the students do not recall by themselves. PedNett use can also remind the students of words which they have already produced in steps 1-5 (before PedNett use) – i.e. induce a reactivation of words. Due to the process of spreading activation, the students can even recall words from their own vocabulary which they have neither seen in PedNett, nor produced in steps 1-5. This happened, e.g., with a student who selected *sosiokulturell teori* 'sociocultural theory' from PedNett in the Motivation task. This informant also put down the new tentative search term *Vygotskij* in association with *sosiokulturell teori*. This term is found in PedNett both as a node and in relationship descriptions, but according to the log of this informant's PedNett use, *Vygotskij* was not displayed during the session. I conclude by assuming that the recognition and activation of the term *sosiokulturell teori* in turn has activated the recall of the term *Vygotskij* from the informant's own vocabulary. One might say that *sosiokulturell teori* worked as a retrieval cue for the term *Vygotskij*, since "[h]ow well we can remember something depends in part on how well we can regenerate the cues to which the memory is associated. [...] Much of memory failure can be attributed to loss of access to appropriate retrieval cues" (Anderson 2000:267). In addition to the potential effects mentioned above, PedNett use can also prompt *serendipity*, which is when searchers make desirable discoveries by accident during the clicking around in PedNett. Since the network is confined to the topical area of pedagogy, many PedNett terms might turn out to be relevant to include as tentative search terms, not only terms associated to the work task facet terms.

The process of spreading activation is a phenomenon in all language processing – written, oral, in 'inner speech' when thinking of something, and in conversation. PedNett is thus only one of several ways to activate relevant terminology when formulating information needs and preparing for the subsequent search process. It is to be expected that several other activities also might activate the students' own vocabulary, e.g., reference interview sessions with an intermediary, 'think-aloud' protocol, discussions in a group, making a brainstorm or writing notes to reveal and formulate the information need to oneself. So why did I chose to use PedNett specifically as a method for activating the students' terminology? I stated in section 3.4.2.2 that the application of the 8 terminological steps in the Revealment study served two purposes: For the students, it was a trigger activity activating and enriching their conceptual frames and made them better prepared for an eventual search session. However, since my primary aim was to find a way to collect data on students' formulation of information needs and knowledge formation process in the prefocus stage of information-based work tasks, the application of PedNett suited my purpose. Making the student informants elaborate the simulated work tasks first without any semantic input and then using PedNett, made it possible for me to single out the effect of language processing on the activation of vocabulary, in a laboratory setting.

3.6 Summary of chapter 3 Empirical study

In chapter 3 I have presented the overall research design for the empirical study, which is divided in two parts. The Prearrangement study deals with the preparation of a semantic network called PedNett, based on teachers' associative data. The PedNett database makes up a tool which is a prerequisite for the second and main part of the study, i.e. the Revealment study, dealing with students' prefocus information need formulation. I have described the methodological theories applied in the Prearrangement and the Revealment studies, as well as the data collection procedure. I have reflected on shortcomings in the research design. Finally, chapter 3 contains some concluding remarks on the integration of the theoretical framework in the empirical study. The next chapter will provide an analysis of the empirical data from the Revealment study.

Chapter

4

Presentation and analysis of empirical data

4.1 Introduction to the analysis of the Revealment study

The previous chapter gave a presentation of the methodological setup of the two different parts of the data collection: The first part of the data collection was called the *Prearrangement study*, i.e. the establishment of a database labelled PedNett, based on teacher informants' word associations. This was presented in full in section 3.3, including the nature of the associative data entered into PedNett. A complete listing of the PedNett home entry vocabulary is provided in appendix 7. The interface of the PedNett database is to be found at http://bibin.hio.no/pednettphd/. The PedNett database can (at least until the PhD defence) be entered with the user name 'phdreader' and the password 'pedsearch'. As the Prearrangement study was only a prerequisite for the Revealment study, it is not a topic for the analysis of empirical data which is the presented in this chapter. The teachers' word associations will just be mentioned briefly in section 4.4.1, in a comparison between the students' vocabulary in their brainstorming to the work task facets, and the teachers' word associations to the same terms.

The second part of the data collection was called the *Revealment study*, with student informants' sessions. The data collection was presented in section 3.4. The object of this chapter is to analyse the empirical data from the Revealment study. I use n=54 in the analysis of student informants recruited from OAUC/Edu[33], referred to as my *sample*. The bulk of the analysis is based on the students' selection and production of terms in the 8 terminological steps. I consider the analysis primarily as a qualitative study. Some descriptive statistics will be used to get an overview of the data material, to be able to select elements for in-depth

[33] OAUC/Edu = the Faculty of Education and International Studies at Oslo and Akershus University College of Applied Sciences.

analysis. I will aim at providing a thorough presentation of the actual data (in the text as well as the appendices), not only collocations. All references in the analysis to numbers of students, terminological steps, numbers of terms, or age, will be written as ciphers (54 students, 8 terminological steps, 4 terms, 23 years, etc.), whereas other numbers will be written with letters (two parts of data collection, informants from three classes, etc.).

The analysis is centred on the 8 terminological steps of the main session performed by the student informants: selection (step 1), brainstorming (2), structuring (3), clarification (4), formulation (5), structure revision (6), clarification revision (7), and formulation revision (8). These steps were thoroughly presented in section 3.4.2.2 of the methodological setup.

Using the 8 terminological steps in the Revealment study is certainly a very controlled data collection method. I have justified the application of a laboratory setting in chapters 1 and 3. The use of terminological steps was necessary for me to be able to collect comparable data from student informants, on a process which cannot be logged in a natural setting. The elaboration of terminological steps also served as a trigger activity for the students, activating their own vocabulary in the prefocus stage. This controlled setting has an impact on the kind of data collected. I will *not* be able to draw conclusions concerning real-life information need formulation behaviour. However, I *can* throw some light on how students in the prefocus stage of information-based work tasks can benefit from their teachers' terminological competence, presented to the students via a semantic tool containing associative data.

In the analysis I will focus on the relationships between terminological step 1 (selection of work task facets), step 5 (formulation of tentative search terms without PedNett use), and step 8 (formulation enrichment, i.e. formulation of a revised set of tentative search terms after PedNett use). In steps 5 and 8 I will focus on the number and character of unique terms, not the number of tentative queries or whether some terms are used several times in different queries. Neither will I focus on the grammatical form of each term (singular, plural), and spelling. I use *terms* to refer to the items produced by the students, collectively called their *vocabulary*.

The remainder of this chapter is arranged as follows: The analysis is structured around *variables*, *examples*, and *patterns* found in the empirical data. I have arrived at the variables from the in-depth studies of each informant. The examples are used to demonstrate the categorization of informants which I have arrived at. The patterns described in this chapter have emerged from the analysis, from my detailed studies of how the variables relate to each other. I use *variables* not as a concept from the universe of statistics, but just to refer to characteristics along which I can group the data, e.g., the variables *PedNett user types,* and *number of terms*. I use six *variables* in the analysis: PedNett user types (4.2), learning style (4.3.1), previous studies in pedagogy (4.3.2), prior knowledge of the assigned work task (4.3.3), number of terms (4.4.2), and formulation behaviour in the prefocus stage (4.5). Appendix 21 provides an overview of each informant's score on these variables, except for the 'number of terms' variable. The last variable listed here, *formulation behaviour*, is very general compared with the other variables, which can be measured or ticked off. The classification of formulation behaviour in the prefocus stage was elaborated to be able to account for the variation among the informants which was not related to the six PedNett user types. However, this part of the analysis (cf. section 4.5) is more tentative than the rest of chapter 4.

I stated that the analysis is structured around *variables*, *examples*, and *patterns* found in the empirical data, and the variables were listed above. The *examples* of student informants are presented in 4.6, which contains typical representatives for each of the six PedNett user types which are used to categorize the empirical data.

The empirical data is very complex, but I have found some emerging *patterns* (cf. 4.7-4.10) between the six variables learning style, number of terms, PedNett user type, prior knowledge of the assigned work task, previous studies in pedagogy, and formulation behaviour in the prefocus stage. I will focus on the integration of the variables learning style, number of terms, and PedNett user types (cf. 4.7). A minor part of the analysis will consist of a presentation of the end-of-session information from the students' main questionnaire (4.11).

In sections 4.12-4.14 I will co-ordinate the results from the analysis in light of my three research questions, before I provide some reflections on the results in light of shortcomings in the research design (cf. 4.15). I will also discuss my results in light of the guidelines I have laid out (in section 3.1.1) for my research design including case-study research with a qualitative approach (cf. 4.16). A summary of the analysis will be provided in section 4.17. The relationships between the theoretical framework, empirical setup, analysis, and discussion of the thesis were visualized in figure 1.1 in section 1.8.

The aim of the analysis in this chapter is to provide answers to my research questions concerning how students formulate their information needs in the prefocus stage, how they can benefit from their teachers' terminological competence, and how students' learning styles affect their formulation behaviour. The results from the analysis will provide me with a better understanding of students' challenges in information need formulation. This knowledge will be used in the next chapter in a discussion of how students can be supported in the prefocus stage of information-based work tasks – with semantic tools in interactive searching, and in information literacy training. This chapter, however, is focused on the analysis which will conclude with my answers to the research questions. I will start by organizing the empirical data into variables, referring to characteristics along which I can group the data. Let us start with the categorization of the student informants into PedNett user types.

4.2 Categorization of informants in PedNett user types

Since I focus on *individual* variations in students' formulation behaviour in the prefocus stage, it follows that individual students will be the unit to use in categorizing the empirical data. Thus, I have searched for recognizable features in the data on how the students terminologically behave during PedNett use. In this section I will present the six categories of PedNett user types resulting from an in-depth analysis of the data material from each student. It may seem a bit premature to start this chapter with a presentation of the categories which eventually came out of the analysis. The rationale behind this solution is that I want to provide the reader with the six user types as a basis for the understanding of the whole analysis. Though I will describe many different aspects of the empirical data – like number of terms and formulation behaviour – we should keep in mind that the main focus in the analysis is the users – i.e. the individual variation and characteristics on group level of the students. After all, the consequences of this study relate to the users, both when it comes to searching system design and information literacy training. I have given the categories the following labels: the PedNett *Applicator*, the Term *Combiner*, the Term *Reactivator*, the Structure *Enricher*, the PedNett *Aloofer*, and the PedNett *Rejecter* (short names in italics).

4.2.1 The PedNett *Applicator*

The PedNett Applicator (henceforth abbreviated the *Applicator*) is attributed to 32 informants. This user type *applies* PedNett as an idea generator to find search term candidates. Since this is what s/he is told to do according to the instructions in the questionnaire, it comes as no surprise that this is the largest category. The Applicator selects PedNett terms in step 8 for the revised set of tentative search terms. Typically, the Applicator also adds several PedNett terms both in step 6 and step 7, so the revised set of tentative search terms in step 8 is made up of a sub-part of PedNett terms applied in steps 6-7. Using PedNett for enriching the brainstorm structure in *step 6* with PedNett terms, applies to all PedNett user types except the Aloofer and the Rejecter. However, the defining characteristic of the Applicator, is the use of PedNett terms in *step 8*. The Applicator type demonstrates that PedNett use can encourage the users' formulation abilities when individual conceptual frames are activated through the mechanism of recognition. Cf. section 4.6.1 for an exemplification of a typical Applicator, and appendix 25 for contents of steps 1-8.

4.2.2 The Term *Combiner*

The Term Combiner (henceforth abbreviated the *Combiner*) is attributed to 6 informants. This user type *combines* two application areas for PedNett – first, s/he selects search term candidates from the network (i.e. the same as the Applicator does) – and second, the Combiner is reminded of terms s/he has produced already (e.g., in the brainstorm), but did not use in the first set of tentative search terms (in step 5). This is called reactivation of individual vocabulary. So the Combiner both applies PedNett terms in step 8, as well as reactivates her/his own terms from previous steps.

Thus, this PedNett user type combines two strategies of PedNett use, both the one known as the Reactivator (of work task facet terms and/or self-produced terms from steps 1-4, cf. next sub-section), as well as the Applicator (of PedNett terms in step 8, cf. previous sub-section). The Combiner has a rich vocabulary, both in steps 2-3 (self-produced) and in steps 6-8 (PedNett terms as well as reactivated self-produced terms). As with the Applicator, the Combiner type demonstrates how users' formulation abilities are encouraged through the mechanism of recognition. As with all the categories except for the Aloofer and Rejecter types, the Combiner uses PedNett to enrich the structure in step 6 with PedNett terms. However, the defining characteristic of the Combiner, is the making of the revised formulation in step 8 by combining terms previously used in steps 1-4, with terms added from PedNett. Cf. section 4.6.2 for an exemplification of a typical Combiner, and appendix 25 for contents of steps 1-8.

4.2.3 The Term *Reactivator*

The Term Reactivator (henceforth abbreviated the *Reactivator*) is attributed to 6 informants. This user type benefits from PedNett use when s/he is reminded of terms produced already (e.g., in the brainstorm), but not used in the first set of tentative search terms (in step 5). So after having used PedNett, the Reactivator selects terms used in steps 1-4 and *reactivates* them in step 8 for the revised set of tentative search terms. Instead of selecting terms from PedNett, the use of PedNett reactivates the students' vocabulary from steps 1-4. This can be work task facet terms provided in step 1, but it can also be self-produced terms from the brainstorm. As with all the other categories (except for the Aloofer and Rejecter types), the Reactivator uses PedNett to enrich the structure in step 6 with PedNett terms. However, the defining characteristic of the Reactivator is the way which the revised formulation in step 8 is made up by terms previously used in steps 1-4. Cf. section 4.6.3 for an exemplification of a typical Reactivator, and appendix 25 for contents of steps 1-8.

4.2.4 The Structure *Enricher*

The Structure Enricher (henceforth abbreviated the *Enricher*) is attributed to 7 informants. This user type does not add any new tentative search terms in step 8. However, this user *enriches* the structured brainstorm (compiled in step 3) with PedNett terms. So the Enricher is characterized by the addition of a few PedNett terms to the structure in step 6. In step 7 the Enricher might add some further words from PedNett, without applying any of them in step 8 – so the Enricher typically has few terms both in step 5 and step 8: Few or no terms are added in step 8, i.e. any terms used in step 8 will be a repetition of one of the terms used in step 5. The characteristic feature of the Enricher user type – to enrich the structure in step 6 with PedNett terms – is also found in the Reactivator, the Applicator and the Combiner user types, but then in combination with other characteristics. This is illustrated in figure 4.1 below in section 4.2.7, in that these three user types are contained within the circle representing the Enricher user type. Cf. section 4.6.4 for an exemplification of a typical Enricher, and appendix 25 for contents of steps 1-8.

4.2.5 The PedNett *Aloofer*

The PedNett Aloofer (henceforth abbreviated the *Aloofer*) is attributed to only 1 informant. This informant is *aloof* (‘hesitant’) in the application of PedNett. The database logs indicate that she enters a few PedNett clusters, but does not make any changes in the set of tentative search terms in step 8 of the questionnaire. She seems to be under little influence from PedNett, and makes only small changes in step 6 and 7. Because of this, the Aloofer intersects slightly with the Enricher user type (as we will see in figure 4.1 in section 4.2.7), indicating a gradual difference between these two user types. The Aloofer informant does not adhere to the instructions in the questionnaire concerning steps 5 and 8: In step 5, URLs for search engines are provided instead of tentative search terms. Step 8 contains a description of an intended search strategy instead of a revised set of tentative search terms. The Aloofer represents the next-to-nothing-end of a continuum of PedNett use, only surpassed by the

Rejecter. Cf. section 4.6.5 for the full description of the only Aloofer informant, and appendix 25 for contents of steps 1-8.

4.2.6 The PedNett *Rejecter*

The PedNett Rejecter (henceforth abbreviated the *Rejecter*) is attributed to 2 informants. The topical vocabulary in steps 2-5 is made up by only work task facet terms selected in step 1. The Rejecter visits the PedNett database, but does not use any of the terms presented there for revision of steps 6-8. So neither self-produced nor PedNett-terms are added, only comments to what was written in previous steps. Cf. section 4.6.6 for a description of one of the two Rejecter informants, and appendix 25 for contents of steps 1-8.

4.2.7 Summary of the categorization of PedNett user types

Table 4.1 below summarize the PedNett user types and how many informants who are found in each category:

Number of informants (n=54)	*Short name of PedNett user types*	*Explanation of PedNett user types*
32	Applicator	The PedNett Applicator applies PedNett terms in step 8 for the revised set of tentative search terms.
6	Combiner	The Term Combiner both reactivates terms from steps 1-4 as well as applies PedNett terms in step 8.
6	Reactivator	The Term Reactivator reactivates terms from steps 1-4 (work task facets or self-produced) and uses them in step 8 for the revised set of tentative search terms.
7	Enricher	The Structure Enricher enriches the structure in step 6 with a few PedNett terms.
1	Aloofer	The PedNett Aloofer visits the PedNett database, but is aloof to applying terms. Makes only slight changes in step 6 and/or 7.
2	Rejecter	The PedNett Rejecter visits the PedNett database, but does not use any of the terms for revision of steps 6-8.

Table 4.1 PedNett user types and number of informants in each category

We note that for Reactivators, Applicators and Combiners, they are Enrichers at the same time. The relationship between the PedNett user types can be illustrated by the following diagram:

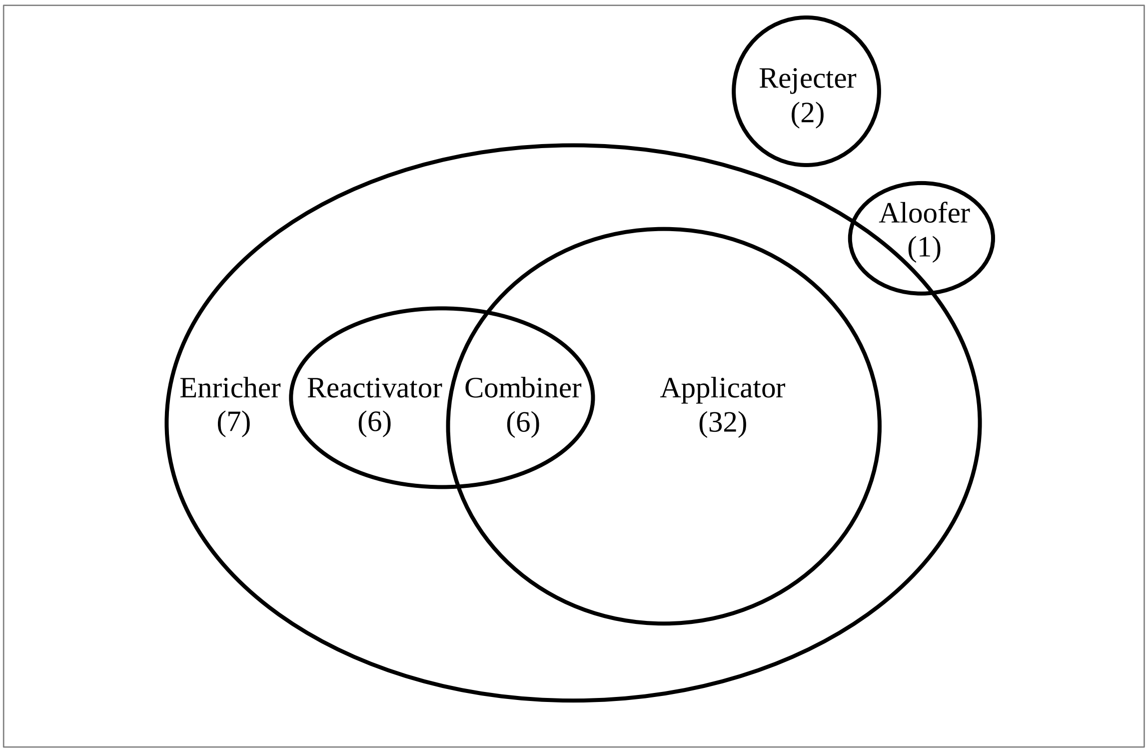


Figure 4.1 Diagram illustrating PedNett user types. Number of informants of each type indicated in brackets.

These categories of PedNett user types will be used in the further analysis (4.3-4.5), and demonstrated by informants who constitute examples of each PedNett user type (4.6). The Applicator type is by far the largest category (32 students), and it also represents the kind of informant who adheres most closely to the instructions given in the questionnaire.

The Aloofer and Rejecter types are necessary in the categorization of PedNett user types pertaining in the empirical data. We noted earlier that extreme results are more likely in small data sets (Kahneman 2011). The smaller categories of PedNett users can be extremes by mere coincidence rather than significance. Accordingly, I will be careful in seeking causes and consequences for them. This is in line with the guidelines I have established for my empirical study (cf. section 3.1.1). The Aloofers and the Rejecter do not in my opinion represent ‘critical cases’ which according to Flyvbjerg can be subjected to generalization. I have not found an explanation why these to user types do not benefit from PedNett use. We have however seen that irrespective of the degree of deep learning style and numbers of self-produced terms, most students will benefit from PedNett use to activate their frame knowledge. So maybe the reason is that the frame knowledge of the Aloofer and Rejecter types is too meagre. It might also be that these students were less sincere in their session performance. This could have been clarified in a post-session interview, but this was not included in my research design.

The establishment of PedNett categories is useful in the analysis, because they illustrate different potential applications of associative networks like PedNett. This kind of semantic tool can be used as a recognition tool for search term candidates (cf. Applicator and Combiner), as well as a trigger for the activation of vocabulary via spreading activation (cf. Reactivator and Combiner). It is also useful as an idea generator for brainstorming and structuring of a work task (cf. Enricher). When I relate the PedNett categories to other variables in the subsequent analysis, I will focus on the Applicators, Combiners, Reactivators and Enrichers.

4.3 Information collected before the 8 terminological steps

In this section I will present the data collected from the pre-session questionnaire, plus the first question of the main questionnaire. We will first look at the learning style test (cf. 4.3.1) and information about previous studies in pedagogy (4.3.2) from the pre-session questionnaire. Then I will present the data on prior knowledge of the assigned work task (4.3.3), as collected from the main questionnaire. These three variables will recur in the analysis of patterns found in the empirical data, cf. section 4.7-4.9, and in the overall patterns provided as figure 4.2 in section 4.10. At the end of the present section I will provide the pre-session questionnaire data on searching experience and terminological challenges (4.3.4) which were not elaborated further in the analysis.

4.3.1 Learning style: The ASSIST test

A learning style test was conducted as a part of the pre-session questionnaire which was filled out when the students were recruited. This Norwegian abbreviated version of the ASSIST test was described in section 3.4.1.2. It contains 24 questions for which the informants were asked to score from 5 to 1, preferably not using score 3 (defined as 5=agree, 4=partly agree, 3=uncertain, 2=partly disagree, 1=disagree). 8 questions cover each of the three learning styles *deep*, *surface,* and *strategic*. Each style is associated with a predominant motivation in the learning process – respectively for *understanding* (deep), *reproduction* (surface), and *achievement* (strategic). Each informant necessarily got a score spanning from 8-40 for each learning style. The informants had the following mean scores and percentages of possible maximum scores for the three learning styles:

	Mean score (range lowest + highest)	*Percentage of possible max. score*
Deep	30.7 (19-38)	78 %
Surface	20.6 (13-35)	53 %
Strategic	28.0 (17-37)	70 %

Table 4.2 Mean score and percentage of possible max score of deep, surface, and strategic learning styles

The numbers in the table above are rather parallel to the mean scores for Heinström's (2002), cf. section 3.4.4.

The ASSIST test is typically used in quantitative studies with statistical calculations, as described in section 3.4.1.2 of the methodological setup. I stated there that I have applied the ASSIST test in a somewhat unorthodox manner, on a data set of 54 informants. In the analysis, I have juxtaposed the students' learning style with other variables in the data, e.g., PedNett learning style and the number of terms used in a specific terminological step. In these comparisons, I have explored several ways to represent the learning style variable. I found that when I sorted the data according to the students' *degree of deep learning style*[34], patterns occurred with respect to values on the other variables, e.g., that the degree of deep learning style *relates* to the number of terms used in terminological step 3, i.e. the structured brainstorm. I use *relate* to refer to patterns/tendencies which are found between variables in the data material, to avoid the more technical term *correlation*, as I will not perform statistical analyses. I will confine myself to the concept of *relate/relationships* – in the meaning 'showing patterns or tendencies found prima facie in the data'. One example is the relationship between a deep learning style in students and their willingness to revise their set of tentative search terms.

The relationship found between the degree of deep learning style and number of terms used in terminological step 3, is: The deeper, the more terms produced by the students. (This is a pattern on a group level, however with large individual variations). I find no such relationship between the degrees of surface and/or strategic learning styles. However, whenever I find a relationship between the degree of deep learning style and another variable, it is also true that the relationship is found simply by looking at the degree of *total* learning

[34] The 54 informants had the following deep scores, listed in descending order: 38, 38, 38, 37, 37, 37, 37, 36, 36, 36, 36, 36, 36, 35, 34, 34, 33, 33, 33, 32, 32, 32, 32, 32, 31, 31, 30, 30, 30, 30, 29, 29, 29, 29, 29, 29, 29, 28, 28, 28, 28, 27, 27, 27, 26, 26, 26, 26, 25, 25, 25, 23, 20, 19. Mean value: 30,72.

style score (summarizing deep, surface and strategic scores). However, since the degree of deep learning style is more specific, I use this as the fixed turning point in the analysis.

Before I arrived at the *degree of deep learning style* as the productive way to sort the learning style variable, I explored several other alternatives, e.g., using the perspective of each informant's *dominating* learning style. To be able to find out whether an informant has got one dominating learning style (or possibly two, or none), I established a cut-off value of 32. I defined that a score of 32 and above for one learning style indicates that this is a strong learning style in an informant, implying a mean score of at least 4 on the 5-point Likert scale (where 4 indicates 'partly agree' and 5 indicates 'agree'). Many of the students did not have any strong learning style at all with this condition, i.e. they did not have a score of 32 or more on any of the three learning styles (each associated with eight questions). In this exploration the students were grouped into the following learning styles according to the ASSIST test: No specific learning style, i.e. score below 32 on all learning styles (21), deep (15), deep-strategic (9), strategic (7), surface (1), surface-strategic (1). We see that several students possess both a deep and a strategic learning style. In studies using statistical analyses of ASSIST test data, one typically finds a positive correlation between deep and strategic learning styles, and negative correlations between deep and surface, as well as strategic and surface learning styles (Aaron & Skakun 1999). It turned out that using the perspective of *dominant learning style* as a turning point in the analysis revealed no patterns in relation to number of terms, PedNett user types, and formulation behaviour. Thus, I will not elaborate these examinations further.

The variable *degree of deep learning style* is juxtaposed with three other variables in pairwise analyses in section 4.7.1 (in relation to number of terms), 4.7.3 (PedNett user types), and 4.9.1 (formulation behaviour in the prefocus stage). These variables characterize the students' behaviour during the informant session, whereas the learning style variable is a quality that they exhibit prior to the session (collected in the pre-session questionnaire). Thus, it is particularly relevant to explore whether a students' learning style can give us any hint of her number of terms, PedNett user type, and formulation behaviour. (I use *hint* because *predict* would allude to statistical significance, whereas I restrict myself to pointing out patterns found in a relatively small sample). I certainly find a relationship between learning style and these other three variables, as the analysis which will be presented in section 4.7.1, 4.7.3, and 4.9.1 will show. In the analysis concerning the degree of deep learning style, I have divided the informants into three groups: Students with a *high* degree of deep learning style (defined as scores from 33 to 38), students with *middle* deep (scores from 29 to 32), and students with a *low* deep (scores from 19 to 28). Each of these categories contains approximately one third of the 54 student informants (19 high, 18 middle, and 17 low).

In addition to learning style, the empirical data contains two other qualities which the students exhibit prior to the informant sessions, i.e. previous studies in pedagogy (cf. section 4.3.2), and prior knowledge of the assigned work task (4.3.3). There are of course several other characteristics which might influence on the students' formulation behaviour, e.g., grade levels and cognitive abilities (intelligence quotient) – however, data on these characteristics were not collected. Diseth (2002) observed no relationship between general intelligence and approaches to learning. However, formulation behaviour might of course be influenced by both approaches to learning and cognitive abilities (as well as several other factors), though each of these factors might be unrelated to each other.

4.3.2 Previous studies in pedagogy and other demographic information

I consider search term selection as an ameliorative and iterative operation throughout the work task process – the students' abilities in producing and selecting adequate search terms are improved by increased topical area knowledge and familiarity with the work task at hand. Vakkari (2000) states that students' search term selection is influenced by their degree of topical knowledge, as well as familiarity with the work task. These matters are reported in this and the following sub-section.

The laboratory setting of the Revealment study ensured comparable conditions in the informant sessions. However, I had to make inquiries about variables which might influence on their performance. There were 40 female and 14 male students with an average age of 23 years (ranging from 20 to 39 years). 51 of them had Norwegian as their mother tongue, one Swedish, one Danish, and one bilingual Norwegian and Urdu. They all conducted their studies with Norwegian as their written language, and they filled out the questionnaires in Norwegian. 8 students had conducted previous studies in pedagogy, varying in length from introductory courses to one-year studies. The 54 students in the data set counted all the students present in three different classes (9, 19 and 26 students), during their lectures on three following days.

In section 4.8.1 I will report on the relationship between previous studies in pedagogy and the number of terms produced.

4.3.3 Prior knowledge of the assigned work task

The informants were presented with a work task at the beginning of the main informant session, cf. section 3.4.2.1 and appendix 15, with a translation in appendix 16. Two different tasks were used, referred to as the *Comprehensive school task* and the *Motivation task*. In the analysis I will specify if the results relates to differences between the students' performance in either of the tasks. (E.g., in the structure revision in terminological step 6, students working on the Motivation task selected a larger number of PedNett terms than the students working on the Comprehensive school task, a difference which will be reported further in section 4.4.2). If nothing else is mentioned, I will treat the results as a whole.

Before the students started working on the 8 terminological steps, they were asked whether they had seen the work task before. 34 students (63 %) had not seen the task before, whereas 20 students (37 %) had seen it – respectively in the electronic learning platform Fronter (15), in class (3 students, i.e. 5-6 % – of which one of them had seen the task in Fronter as well), or having made an outline (3 students, i.e. 5-6 % – all of them on the Motivation task). In addition, 1 student (i.e. 2 %) had written about the comprehensive school as an exercise, but not in the context of the other facets of the Comprehensive school task. In section 4.8.2 I will report on the relationship between prior knowledge of the given work task and the number of terms produced.

4.3.4 Self-reported searching experience and terminological challenges

In the pre-session questionnaire, the informants were asked about their searching experience and terminological challenges in search term selection. All the informants were familiar with the Internet: 43 students (80 %) had used Google or other searching machines for at least 7 years, whereas the remaining 11 students (20 %) had 4-6 years of experience. Most of them used Google or other searching machines daily or weekly. They used library catalogues and article databases more scarcely, as indicated in table 4.3 below (in which I indicate both the number of informants as well as percentages of the sample, to make the data presentation more consistent with the analysis of the end-of-session questionnaire in section 4.11):

Alternatives in the questionnaire	*Never*	*1-2 a year*	*1-2 a month*	*1-2 a week*	*More often/ daily*
Google or other Internet searching machines	-	-	2 (4 %)	14 (26 %)	38 (70 %)
Library catalogues, e.g., Bibsys or the public library	2 (4 %)	17 (32 %)	30 (56 %)	4 (6 %)	1 (2 %)
Article databases, e.g., ERIC	27 (50 %)	21 (39 %)	6 (11 %)	-	-

Table 4.3 Self-reported searching experience

These findings are not surprising. Kuhlthau, Maniotes & Caspari (2007:82) states that "[m]any students' research is reduced to Google and Internet searches". Since I collected the empirical data in 2009, the information behaviour of young people has moved even further in the direction of 'Googling' as the preferred information searching behaviour (Beheshti & Large 2013; Devine & Egger-Sider 2014; Nicholas & Clark 2013). Thus, if a PedNett kind of tool is going to be useful for students, it has got to be available where they are – at the open Internet, rather than in closed databases. This will be further discussed in chapter 5.

When asked about the terminological challenges associated with searching, most of my student informants found search term selection easy:

Terminological challenges	*Very easy*	*Easy*	*Neutral*	*Difficult*	*Very difficult*
Search term selection challenge *)	5 (9 %)	22 (41 %)	25 (46 %)	2 (4 %)	0
Rephrasing search terms **)	2 (4 %)	23 (42 %)	20 (37 %)	9 (17 %)	0

*) How easy or difficult do you find it to choose which terms you want to use when searching the Internet, library catalogues or article databases to find information for some work task in association with your studies?

**) If you perform a search and you don't find what you are looking for (e.g., because you get zero – or thousands – of hits): how easy or difficult do you find it to think of other terms to use in a second search?

Table 4.4 Terminological challenge associated with searching

We see that very few students (only 2, i.e. 4 %) find first term selection difficult, whereas 9 students (17 %) found rephrasing difficult. The most common reason provided by the students who found search term selection or rephrasing difficult, was 'finding the suitable terms'. Other challenges were 'too many hits', 'quality and relevance judgements', and 'spelling'. It is worth noting that the students found rephrasing more difficult than first term selection, keeping in mind possible benefits of PedNett use for search term revision.

I found no relationships between perceived challenges in search term selection and learning style, not even for the 9 students who found rephrasing difficult – they belong to various learning style categories. Using 32 as a cut-off-value (cf. section 4.3.1), 2 had deep learning style, 2 had strategic, 1 deep strategic and 4 had no specific learning style. Neither do I find a pattern between searching experience and PedNett user types or any of the other variables. Searching experience and/or terminological challenges as reported in the pre-session questionnaire is not reported further in the analysis.

4.3.5 Summary of information collected before the 8 terminological steps

In section 4.3 I have presented the data collected from the pre-session questionnaire, plus the first question of the main questionnaire. In the analysis of the ASSIST test, I arrived at *degree of deep learning style* as a useful turning point, which will be related to the variables number of terms (cf. section 4.7.1), PedNett user types (4.7.3), and formulation behaviour in the prefocus stage (4.9.1) in the subsequent analysis. The findings concerning previous studies in pedagogy will be related to the variable number of terms in section 4.8.1, whereas the findings concerning prior knowledge of the given work task and the number of terms, will be treated in section 4.8.2. Self-reported searching experience and terminological challenges were reported in section 4.3.4.

4.4 The students' vocabulary before and after PedNett use

When studying the topical area of pedagogy, the students have to gain "knowledge and visions about teaching- and learning processes, about how children learn and develop, and how they meet with their surroundings"[35] (Imsen 2005:23). The students have to develop a "professional occupational language"[36] with their own vocabulary containing terms fetched from educational psychology (Imsen 2005:24). The empirical study indicates that vocabulary development is an important aspect in the students' training, and that they had come far in acquiring the same vocabulary as their teachers. In section 4.4 I will explore the students' vocabulary in several ways. First, I will compare the students' self-produced terms in steps 3 and 5 with the teachers' word associations, as well as the dictionary *Pedagogisk ordbok* (Bø & Helle 2008), cf. section 4.4.1. Then I will look at number of terms in steps 3, 5, and 8

[35] My translation. Original text: "kunnskap og visjoner om undervisnings- og læringsprosesser, om hvordan barn lærer og utvikler seg, og hvordan de opplever sine omgivelser".
[36] My translation. Origianal expression: "profesjonelt yrkesspråk".

(4.4.2). Finally, I will characterize the students' PedNett use according to the logs of recorded use during the informant session (4.4.3), before I make a summary of this section (4.4.4).

4.4.1 Characterization of the students' vocabulary in steps 3 and 5

After having identified the work task facets in terminological step 1, the students were asked in step 2 to perform a two minutes uncensored brainstorming over associations after having read the work task question, writing down words helter-skelter as they popped up in their minds. In step 3 the students were asked to spend 2-3 minutes structuring the brainstorm. They were asked to make a table, using the selected work task facets as column headers. The brainstorm words were to be organized into this structure. They were allowed to add, remove or rephrase words during the organization process.

The students' brainstorm vocabulary can be considered as an indication of the students' frame knowledge of the work task facets which they selected when they were presented with the task. I will compare the vocabulary of the students and the teachers, by comparing the words used in the student's structured brainstorm in step 3, with the associations performed by the teachers in the word association testing used as raw material for the PedNett database. Appendix 22 provides a comparison between the students' terms used in the structured brainstorm in terminological step 3 in the *Motivation task* (non-topical terms and phrases are not included), and the teacher's word associations to the work task facet terms. For each term produced by the teachers in the word association test (89 different terms), I indicate whether the same term is also found in the students' brainstorm. When it comes to the extent of concurrence between the teachers' and the students' vocabulary, the table in appendix 22 indicates that 37 % of the teachers' word associations (33 terms) are found in the students' brainstorm. This indicates that in using PedNett, the students are both reminded of words they are familiar with (i.e. words which are entrenched in their own vocabulary), as well as confronted with less familiar words, for which they are provided with their associative context in the topical area, and an opportunity to add to their current knowledge.

In the comparison above I use the Motivation task, because: There is a difference between the Comprehensive school task and the Motivation task when it comes to how many times each of the work task facets have been processed as stimuli words by the teacher informants. The reason for this was reported in section 3.3.6. The facets for the Comprehensive school task are processed much fewer times, and two of the facets have not been used as stimuli words (cf. section 4.4.2 below). Thus, there are fewer word associations by the teachers to match onto the students' vocabulary. I have therefore not made any calculation of how many of the teachers' word associations which are found in the students' brainstorm vocabulary for the Comprehensive school task.

In step 3 the students produced mostly nouns, verb and verbal nouns, but also phrases and sentences. Semantically much of the vocabulary was related to teaching practice (e.g., *planlegging* 'planning', *variasjon* 'variation', and *samarbeid* 'cooperation'), attitudes (to pupils, parents, one's own competence – e.g., *forståelse* 'understanding', and *respekt* 'respect'), perspective terms related to attitudes or values (e.g., *ta vare på verdier* 'defend values', *utfordringer* 'challenges', *ulike nivåer* 'different levels', *de svakeste* 'the weakest ones') or angle of incidence (e.g., *historie* 'history', *politikk* 'politics', and *kultur* 'culture'), facts like years, names (e.g., *Piaget* and *Vygotskij*), and book titles (e.g., *Imsen: Elevens verden*), and examples (e.g., listings of teaching strategies like *lesing* 'reading', *skriving* 'writing', or teaching topics). Phrases and sentences contained statements or rhetoric points like *alle elever er likeverdige* 'all pupils have equal worth', *elev=ressurs* 'pupil=resource', and *Hvordan få til en inkluderende opplæring?* 'How accomplish an inclusive education?'. The students' brainstorms also contained some non-topical terms like *diskutere* 'discuss', *definere* 'define', *beskrive begrepet* 'describe the concept', and *sammenligne* 'compare'. The brainstorm terminologies are very individual – many of the brainstorm terms were produced by only one student. This is as expected, since frames are individual and the words activated by a work task will depend on each individual's frame content.

Both the students' brainstorming and the teachers' word associations have been produced 'on the spur of the moment' – what came into the informants' mind triggered by (in the students' case) the work task, or (in the teachers' case) the stimuli words presented to them. The teachers produced mainly nouns – typically pedagogic terms (like *mestringsmotivasjon* 'mastery motivation', *helklasseundervisning* 'teaching in full classes', and *flerkulturell pedagogikk* 'multicultural pedagogy'), more common words from everyday language (*likestilling* 'equality of status', *menneskeverd* 'human worth'), as well as expressions used in the discourse of the teaching setting, and probably in the students' curriculum (e.g., *hode-hånd-hjerte* 'head-hand-heart). Most of the word associations produced by the teachers are associatively related to the stimulus word. A few exceptions are found as synonyms (*sosiale vansker* 'social problems' – *atferdsproblemer* 'behaviour problems'), or near-synonyms (*fellesskole* 'comprehensive school' – *enhetsskole* 'comprehensive school'), as well as a few narrower terms (*motivasjon* 'motivation' – *indre motivasjon* 'intrinsic motivation'), and broader terms (*spesialpedagogikk* 'special pedagogy' – *pedagogikk* 'pedagogy'). Cf. appendix 7 for a complete listing of the PedNett home entry vocabulary, which contains the sum of words occurring as stimuli and/or response words.

When we compare the students' and the teachers' spontaneous vocabulary, we have to remember that the activities of brainstorming and providing word associations in the present empirical study are very different, especially in one respect. The students' brainstorming is made within the *context* of a work task in which the work task facets are understood in relation to each other, whereas the teachers' word associations are made to one stimulus word at a time, each stimulus word only related to the larger context of pedagogy. So the teacher's word associations provide the teachers' frame knowledge associated with the stimuli words, whereas the students' brainstorm provides the students' frame knowledge associated with the work task facets. Accordingly the brainstorms include quite a few terms related to how the students want to treat the topics to be discussed in the task, like terms related to values and attitudes, examples, and non-topical terms. These terms are used to structure the work task, but they are not used later on as tentative search terms. These are typically left out in terminological step 5. Since the teachers are experts in the topical area, their vocabulary is richer and more readily available for them, as compared to the students' vocabulary. Presenting the students' with the PedNett database containing the teachers' vocabulary, contributes in narrowing the gap between the students' terminology and the vocabulary found in documents containing work-task related information.

In appendix 22, as commented above, we compared the students' step 3-vocabulary with the teachers' word associations. We will now look at steps 5 and 8. Appendix 23 contains an accumulation of the student informants' selection of work task facet terms (step 1), their formulation of tentative search terms (step 5), and their revised formulation after having used PedNett (step 8), for the Motivation task. The student's vocabulary in steps 5 and 8 are characterized as to whether the terms concur with entries in the dictionary *Pedagogisk ordbok* (Bø & Helle 2008), and in PedNett.

The students and the teachers had almost the same number of terms found in the dictionary, cf. appendix 23: 52 % of the students' vocabulary in step 5 in the Motivation task and 57 % of the teachers' word associations concurred with *Pedagogisk ordbok*. (Terms which are not found in the dictionary, are typically related to practical teaching, since the dictionary is more theoretically oriented than the students' and the teachers' vocabulary). Furthermore, for the same work task, 67 % of the students' tentative search terms (apart from the work task facet terms) in step 5 are found in PedNett. Examples of step-5 terms which are *not* found in PedNett, are references to specific documents (*Imsen: Elevens verden*), and phrases (e.g., *Motivasjonsfaktorer i skolen* 'factors of motivation in the school').

We saw above that the students' brainstorm terms in step 3 contain 37 % of the teachers' word associations, i.e. they are PedNett entry terms. Why, then, the much higher percentage of 67 % as the amount of the step 5-terms coinciding with PedNett? This must be because the activity of brainstorming in its nature is widening the scope and is 'all-inclusive', whereas the selection of tentative search terms is a process of narrowing the scope and pin-pointing the work task topic. In step 8, almost all of the terms are found in PedNett, which is not surprising when we think of the instruction in the questionnaire, i.e. to use PedNett in revising the set of tentative search terms. This is an obvious example of how the controlled setting of the research design influences the resulting empirical data.

We have now seen that the students in the Revealment study and the teachers in the Prearrangement study have a rather similar vocabulary when it comes to the *kinds* of terms used (if we leave out non-topical terms and terms related to organizing the students' work task). Thus, it is *not* as if the teachers' vocabulary is much 'more pedagogical'. However, the teachers' frames are *richer* and easier *accessible* for them, because the teachers – as experts in the topical area – are terminologically more experienced, and their vocabulary is more entrenched. The students' potential benefit from using PedNett will be to *activate* their frame knowledge, in that the recognition of terms in PedNett will activate the students' own vocabulary. Using PedNett might also induce an *enrichment* of the students' frame knowledge.

4.4.2 Number of terms used before and after PedNett use

In this section I will look at number of terms in step 1 (selection of work task facets), steps 3 and 6 (structured brainstorm before and after PedNett use), and steps 5 and 8 (formulation of tentative search terms before and after PedNett use). Information on term frequencies in the brainstorm and in search term selection *before* and *after* PedNett use will give us an indication of the potential benefits of semantic tools like PedNett in information need formulation. If PedNett enhances the activation of current knowledge, this kind of semantic input should be available for users, adapted to the information searching behaviour of the Google generation.

Let us first have a look at the mean numbers and variation span in number of terms in steps 1, 3, 5, 6 and 8. In step 8 I have only counted terms *added* in this step, not the accumulation of step 5-terms which are kept, in addition to terms fetched from PedNett:

n=54	*Step 1 Selection*	*Step 3 Structuring*	*Step 5 Formulation*	*Step 6 Structure revision*	*Step 8 Formulation revision*
Mean number of terms	5.2	10	3.7	11.0	3.8
Comprehens. school task	6.3	9.4	4.0	8.9	4.1
Motivation task	4.1	10.8	3.5	13.3	3.5
Variation span in number of terms	3-11	4-25	0-7	0-29	0-14

Table 4.5 Number of terms in terminological steps 1, 3, 5, 6 and 8

The mean number of terms in step 6 varies a lot between the two work tasks, with a mean number of 8.9 for the Comprehensive school task, and 13.3 for the Motivation task. This is caused by the large difference in the number of PedNett terms associated with the work task facet terms in each work task. The Comprehensive school task contains 6 work task facets and had 5 processings, distributed on 3 of the facets: *likeverd* 'equality' (3), *enhetsskole* 'comprehensive school' (1), *flerkulturell skole* 'multicultural school' (1). *Likhet* 'likeness', *inkludering* 'inclusion', and *inkluderende opplæring* 'inclusive education' were not processed in the word association test, which of course is a drawback in the research design.

The Motivation task contains 5 work task facets and had 19 processings: *læring* 'learning' (8), *motivasjon* 'motivation' (6), *undervisning* 'teaching' (3), *læringsstrategier* 'learning strategies' (1), and *Kunnskapsløftet* 'the Knowledge Promotion reform' (1). In table 4.5 above we note that the variation in the number of work task facets covered as entry terms in PedNett had little influence on term frequencies in step 8. However, step 6 exhibits a large variation between the two work tasks on this matter. Due to this variation, I will *not* use step 6-frequency in the further analysis, but focus on steps 3, 5, and 8 (cf. grey areas in table 4.5 above).

In step 1, the informants selected approximately 5 work task facets, with a variation between the two work tasks which is explicable by the fact that the Comprehensive school task had 6 work task facets, whereas the Motivation task had 5 facets (cf. appendix 16). Steps 3, 5, and 8 had rather similar numbers of terms in the two work tasks, so I will use the mean number across the work tasks for these steps. Step 5-terms primarily consist of work task facet terms (approximately 67 %), whereas the rest of the terms are produced by the informant (in steps 2-5). The self-produced share of step5-terms is a little larger for the Motivation task, almost 50% as opposed to 33% for the Comprehensive school task.

Step 8-terms consist almost exclusively of PedNett terms, either terms related to the work task facet terms, or any other terms from PedNett. Some very few step 8-terms are reactivations of work task facet terms (from step 1) or self-produced terms (from step 2-4). The PedNett clusters for the work task facet terms of the Motivation task are richer than for the Comprehensive school task. Accordingly, a much larger proportion of step 8-terms from students' work on the Motivation task is directly associated with work task facet terms, whereas for the Comprehensive school task, the PedNett terms are selected from a wider set of PedNett clusters. Cf. appendices 8-10 for examples of PedNett clusters.

4.4.3 Characteristics of PedNett use according to the logs

In section 3.4.2.4 I described how each informant's movements in PedNett were logged and registered in a database. An example of these logs is provided in appendix 17. The first lines of each log indicate that the students started their PedNett sessions by testing the functionality of the network according to the directions provided on p. 7 of the main questionnaire (cf. appendix 13, translated in appendix 14).

I have used the logs to confirm whether terms added in steps 6-8 have been displayed during the informants' sessions – which it turns out that they have. This means that most of the terms added in steps 6-8 are selected from PedNett – or they have been produced by the informant in steps 2-5. I have found no examples of informants adding a term in step 6, 7, or 8, which had neither occurred in the PedNett session, nor in previous terminological steps. This is not a matter of course – I was curious as to whether activating frame knowledge by working in PedNett also would make the students come up with new terms from their own frames.

With respect to the second research question (How do students in the prefocus stage utilize teachers' frame knowledge expressed as word associations and relationship descriptions in the semantic network PedNett?), the students seem to select search term candidates primarily from the *word associations* in the PedNett clusters. Practically all the terms selected by the students in steps 6-8 are PedNett *entry terms* (i.e. stimuli or response words). Only a couple of terms are fetched from the *relationship descriptions*. The relationship descriptions are used by the students for other purposes, e.g., to check their understanding of a PedNett term (cf. section 4.11.3 on students' opinions of PedNett's functionality).

The mean length of a log (counted as number of lines) is 51.5. The length varies a lot between the informants, from 0 to 107. The informants with a log length of 0, 5, 6, and 8 spent their time scrolling up and down the PedNett home page, selecting words from the entry vocabulary without accessing (m)any PedNett clusters. They are not rejected from my sample. They seem to have benefited from this; two of them being Combiners, and two Applicators.

There is no obvious pattern in the relation between log length and degree of deep learning style. Informants with a deep score between 28 and 40 have a mean log length around the mean log length (i.e. 51.5) for the total sample. Deep score 36-40 (13 informants) had a mean log length of 50.9, deep 32-35 (11 inf.) had 54.2, and deep 28-31 (17 inf.) had 50.1. Deep 24-27 (10inf.) had 42.3, whereas deep <=23 (3 inf.) had log length 72.

Through the logs I have also been able to check whether the informants only used the PedNett clusters corresponding to the work task facets, or whether they clicked their way further around in the network. There is a major difference between the two work tasks on this matter. This is caused by the large difference in the number of processings of the work task facet terms for the two tasks (cf. section 4.4.2).

For the Comprehensive school task there were only three PedNett clusters covering the work task facets, so the informants were soon 'forced' into the remaining network. The students working on the comprehensive school task, selected a scattered set of PedNett terms to be used in steps 6-8. For the Motivation task, the informants had 5 PedNett clusters, covering all the work task facets. The students working on this task had accordingly a much richer set of terms closely related to the work task facets. The logs of PedNett use indicate that the students 'stayed longer' in the PedNett clusters for the work task facets, and accordingly used more terms from these clusters. The mean log length for the Comprehensive school task is 54, whereas the corresponding value for the Motivation task is 48.8, which is not surprising in light of the difference in 'richness' in PedNett clusters for the two tasks.

The log data gives no basis for claiming any relationship between PedNett user types and log length. If we ignore the Aloofer (1 informant) and Rejecter (2 inf.) PedNett user types and concentrate on the four large categories, they come in the following order of decreasing log length: Enricher (61.4), Applicator (51.0), Reactivator (50.8), and Combiner (42.8). Applicators, as the largest group (32 informants), and representing the category of informants who utilize PedNett according to the instructions in the questionnaire, is very close to the mean length for the total sample. We might ask why the Enrichers have the longest logs, when they only enrich the structure in step 6 with a few PedNett terms, and do not add any PedNett terms in step 8. Most of the Enrichers worked on the Motivation task (6 out of 7), and had a mean log length of 53.8. The explanation is found with the 7th informant (working on the Comprehensive school task) who had a log length of 107 – and thus skewed the result.

4.4.4 Summary of the students' vocabulary before and after PedNett use

In section 4.4 I have explored the students' vocabulary, both when it comes to choice of words, and frequencies. We saw that the students in the Revealment study have a rather similar vocabulary to the teachers' word associations in the Prearrangement study, when it comes to the kinds of terms used – the teachers do not have a more 'pedagogical vocabulary'. However, the teachers' frames are richer, so the students might benefit from using PedNett to activate their own vocabulary. When it comes to term numbers, I arrived at a decision to use number of terms in steps 3, 5, and 8 in the further analysis, because they have comparable mean numbers for the two work tasks. Finally, I characterized the students' PedNett use according to the logs of recorded use during the informant session, and I discussed reasons for variations in log length.

4.5 Classification of formulation behaviour in the prefocus stage

In section 4.2 I categorized the informants in six PedNett user types. However, the informants also vary a lot in other respects than PedNett use. To be able to describe this variation, I have elaborated a classification of formulation behaviour in the prefocus stage, which will be presented below. I have coded the informants according to ten characteristics, for which I have invented the labels *facet-embracing, phrasing, facet-trusting, self-production, first-patching, narrowing, fastening, final-patching, removing,* and *adjusting*.

I used several inspirational sources for the compilation of formulation characteristics (Bates 1979; Fidel 1991c; Lykke, Price & Delcambre 2012; Vakkari 2000), before I arrived at my own classification of prefocus formulation. Bates (1979) identifies 29 search tactics divided into the categories monitoring (quality control), search formulation tactics (i.e. query formulation), term tactics, and file structure tactics. A few of my 10 formulation behaviour characteristics resemble some of Bates' search tactics, especially in the category *term tactics,* involving, e.g., *super* (parallels first-patching), *sub* (narrowing), or *respell* (adjusting).

Bates' *term tactics* are tactics performed to aid in the selection and revision of specific search terms. This resemble Fidel's (1991c) *conceptual moves*, i.e. moves changing the meaning of a query formulation, e.g., by selecting narrower or broader terms. However, the concurrences of Bates' search tactics, Fidel's moves, and my characteristics are small, as their tactics concern actual searching, including reformulation of queries.

Vakkari (2000) makes his own classification of 'strategies to begin a session', 'search formulation tactics' (i.e. query formulation), and 'other tactics', inspired by Bates (1979), Fidel (1991c) and others. In his longitudinal study of students' changes of search terms and tactics during task performance, his informants perform three searching sessions. He finds that the students gradually acquires a richer and more precise vocabulary with more synonyms, narrower terms, and related terms, whereas broader terms are left out in the later sessions. Vakkari (2000) expresses characteristics of students' formulation behaviour which I also find in my empirical data:

> We found that the degree of students' knowledge of the topic predicts their ability to express search terms and formulate tactics. The less they know, the fewer, broader and more vague terms they use and the shorter queries and simpler tactics they formulate. The evident conclusion is that people with scarce domain knowledge need support for expanding and differentiating their conceptual model of the topic. This would help them to develop ideas on how to structure the topic and how to express their vague information needs more in detail. Equipped with synonyms and the narrower terms provided by the system they could reformulate their query using terms with stronger differentiation power. This would result in finding more relevant information items. Vakkari (2000:18)

Since the sources cited above all concern online searching and not the prefocus stage specifically, I found it most applicable to select my own set of terms to refer to the move types (i.e. formulation behaviours). These will be explained and exemplified in sections 4.5.1-4.5.10 below. Some of the formulation behaviours appear *to a certain degree*, not either – or. These distinctions are indicated by the use of parentheses around less obvious characteristics in the informant overview in appendix 21, e.g., (Ph) versus Ph when an informant uses phrase level only to a certain degree. The ten formulation behaviours are found all across the PedNett user types (the Enricher, the Reactivator, etc.). In section 4.6 (containing an in-depth exemplification of each PedNett user type), I have indicated examples of formulation behaviour (e.g., *facet-embracing, facet-trusting, first-patching*, etc.) which are found in the terminological data in each informant presentation. I will comment on the relationships between each *pair* of formulation behaviours in section 4.5.11, and illustrate these relationships in appendix 24.

Two characteristics are assigned to a majority of the sample, i.e. self-production and facet-trusting. These two characteristics appear along a continuum from a large amount of self-production to strongly facet-trusting (as will be explained below in 4.5.3-4.5.4). The eight remaining characteristics are assigned to minority selections of the informants. Some of the characteristics never co-occur. This applies, e.g., to first-patching and narrowing, which is demonstrated in the illustration in appendix 24.

4.5.1 Facet-embracing

The characteristic of formulation behaviour called *facet-embracing* concerns step 1, and appears with 14 informants. These informants select extra many terms in step 1, not only typical work task facets. This can be exemplified by an informant who – in addition to the 5 work task facets (*motivasjon* 'motivation', *læring* 'learning', *undervisning* 'teaching', *Kunnskapsløftet* 'the Knowledge Promotion reform', and *læringsstrategier* 'learning strategies') in the Motivation task – selects the non-topical terms *drøft* 'discuss', *begreper* 'concepts', and *betydning* 'meaning'. Facet-embracing is demonstrated in section 4.6 in the Combiner and Aloofer PedNett user types.

4.5.2 Phrasing

The characteristic of formulation behaviour called *phrasing* concerns some/all steps from 2-8, and appears with 6 informants. These informants work at phrase or sentence level rather than at word level. This can be exemplified by an informant who adds sentences rather than words in each column in step 3 (structuring of brainstorm), e.g., *Kunnskapsløftet: hva sier LK06 mer eksplisitt om motivasjon* 'The Knowledge Promotion reform: What does [the document] LK06 say more explicitly about motivation', and *Læring: stor korrelasjon mellom god læring og høy lyst til å lære* 'Learning: strong correlation between good learning and strong motivation for learning'. Phrasing is demonstrated in section 4.6 in the Aloofer PedNett user type. Phrasing does not co-occur with first-patching, fastening, or final-patching. Everyone demonstrating phrasing also shows facet-trusting, and 5 out of 6 are also facet-embracing.

4.5.3 Facet-trusting

The characteristic of formulation behaviour called *facet-trusting* concerns steps 1, 4 and 5, and appears with 45 informants (and is thus by far the largest category). These informants stick to the work task facet terms (selected in step 1) in step 4 (clarification of information need) and onto step 5. Facet-trusting appears along a continuum from strongly facet-trusting to a large amount of self-production, cf. section 4.5.4 (i.e. when the informant adds self-produced terms in step 5). Somewhere in the middle we can, e.g., find informants who stick to the work task facet terms in step 4, and then adds other terms than work task facet terms in step 5, e.g., terms produced in step 2 (brainstorm). This can be exemplified by several informants who select the work task facet terms *motivasjon* ‘motivation’, *læring* ‘learning’, and *undervisning* ‘teaching’, and stick to these terms in step 4 and 5 – with or without other terms added. Facet-trusting is demonstrated in section 4.6 in all the PedNett user types.

4.5.4 Self-production

The characteristic of formulation behaviour called *self-production* concerns step 5, and appears with 31 informants (the second largest category). These informants add self-produced terms in step 5, with little or no use of the work task facet terms, or in addition to these. This formulation behaviour appears along a continuum from a large amount of self-production to strongly facet-trusting, cf. section 4.5.3 (i.e. when the informant sticks to the work task facet terms (selected in step 1) in steps 4 and 5). For example, in the Motivation task an informant adds *attribusjon* ‘attribution’ as a tentative search term in step 5, in addition to *motivasjon* ‘motivation’, *læring* ‘learning’, and *undervisning* ‘teaching’. Self-production is demonstrated in section 4.6 in the Enricher and Applicator PedNett user types.

4.5.5 First-patching

The characteristic of formulation behaviour called *first-patching* concerns the number of terms in step 5, and appears with 10 informants. These informants use only one tentative search term in step 5, even though several other terms have been used to represent the work task and information need in step 3 and 4. This first-patch term is often of a general kind, and represents only one out of several work task facets. First-patching in prefocus formulation resembles the *label effect* in online searching, cf. section 2.5.4.3 and Ingwersen (1992, 1996). When the similar operation is done in step 8, it is called final-patching (cf. section 4.5.8 below). First-patching never appears in combination with narrowing (cf. section 4.5.6). For example, after having produced lots of terms in steps 2-4, an informant selects only one tentative search term in step 5, expressed as the main work task facet (*enhetsskolen* ‘the comprehensive school’) in the Comprehensive school task. First-patching is demonstrated in section 4.6 in the Enricher and Reactivator PedNett user types.

4.5.6 Narrowing

The characteristic of formulation behaviour called *narrowing* concerns step 5, and appears with 8 informants. These informants use more specific term(s) in step 5 than what was provided in the work task facet terms. Narrowing never appears in combination with first-patching (cf. section 4.5.5). This can be exemplified in association with one of the work task facet terms in the Motivation task is *undervisning* ‘teaching’. In step 5 some of the informants produce *undervisningsmetoder* ‘teaching methods’ as a tentative search term. With the same work task, several informants use the narrower terms *indre motivasjon* ‘intrinsic motivation’ and *ytre motivasjon* ‘extrinsic motivation’ in step 5 – and if not, they frequently select these terms from PedNett in step 8. Narrowing is demonstrated in section 4.6 in the Applicator PedNett user type.

4.5.7 Fastening

The characteristic of formulation behaviour called *fastening* concerns term selection in step 8, and appears with 9 informants. These informants add PedNett terms in steps 6 and 7, but stick to her/his original terms from steps 1-5 in step 8 (i.e. adds no new PedNett-terms in step 8). Fastening in prefocus formulation resembles the *anchoring effect* in online searching, cf. section 2.5.4.3 and Blair (1990). For example, one informant who has selected *enhetsskolen* ‘the comprehensive school’ as a tentative search term in step 5 in the Comprehensive school task, then adds a lot of PedNett terms in steps 6 and 7. When revising the tentative search terms in step 8, the informant selects the terms *inkludering* ‘inclusion’ and *flerkulturell skole* ‘multicultural school’, two terms which were already selected as work task facets in step 1. Fastening is demonstrated in section 4.6 in the Enricher and Reactivator PedNett user types.

4.5.8 Final-patching

The characteristic of formulation behaviour called *final-patching* concerns the number of terms in step 8, and appears with 5 informants. These informants end up with only one tentative search term in step 8 (which is not fetched from PedNett), though s/he might have used a rich self-produced vocabulary in steps 3 (structuring) and 6 (structure revision), covering several work task facets and their associations. The operation of final-patching in step 8 resembles first-patching in step 5, in that only one term is used to represent the information need.

With final-patching, no new PedNett-terms are added in step 8. For example, one informant adds 25 PedNett terms in step 6, but uses none of them in step 8. Another informant identifies 3 terms in step 4 (clarification): *motivasjon* ‘motivation’, *læring* ‘learning’, and *undervisning* ‘teaching’ and then selects the tentative search terms *motivasjonens betydning* ‘the importance of motivation’ and *definisjon undervisning* ‘definition of teaching’ in step 5. She then adds 15 PedNett terms in step 6 (structure revision), before she removes *læring* ‘learning’, and *undervisning* ‘teaching’ in step 7 (revised clarification), and ends up with one tentative search term in step 8 representing the whole information need: *motivasjon* ‘motivation’. Though both fastening and final-patching concerns step 8, they refer to different phenomena. Fastening concerns term selection, whereas final-patching concerns the number of terms. So fastening concerns the holding-on (in step 8) to original terms used in steps 1-5 (though the informant has been confronted with several terms and also possibly used them in steps 6-7) – whereas final-patching concerns the selection of one single term to represent the whole information need. Final-patching is demonstrated in section 4.6 in the Enricher and Rejecter PedNett user types.

4.5.9 Removing

The characteristic of formulation behaviour called *removing* concerns steps 6, 7 and 8, and appears with 11 informants. In the course of using PedNett in steps 6, 7 and 8, these informants remove one or several self-produced terms from previous steps. This can be interpreted as an ability to get an overview of the work task, and single out aspects which are not given priority in later steps. For example, one informant produces *VAKT-prinsippet* ‘the principle of using Visual, Auditive, Kinaesthetic, and Tactile learning channels’ in steps 2 and 3, and then removes this term in step 6 during PedNett use. In this situation, PedNett is used in the focusing of the work task. Removing is demonstrated in section 4.6 in the Combiner user type (citing the same informant as used above), and in the Rejecter PedNett user type.

4.5.10 Adjusting

The characteristic of formulation behaviour called *adjusting* concerns steps 6, 7 and 8, and appears with 3 informants. These informants use PedNett in steps 6, 7 and/or 8 to adjust the form of their self-produced terms from previous steps. For example, one informant produces the tentative search term *skolehistorikk* ‘school history’ in step 5, but changes it to *skolehistorie* ‘school history’ after having seen that form as an entry in PedNett. Adjusting is demonstrated in section 4.6 in the Reactivator PedNett user type.

4.5.11 Relationships between pairs of formulation behaviour

The relationships between each pair of formulation behaviours are demonstrated in appendix 24. The appendix aims at indicating to what extent formulation behaviours co-occur. Inclusion means that one formulation behaviour applies to a sub-set of another formulation behaviour – e.g., 6 of the 45 informants exhibiting facet-trusting, also exhibit phrasing – so phrasing is included in facet-trusting. Some combinations of formulation behaviours never co-occur. Most pairs of formulation behaviours, however, intersect to a certain degree. The illustration in appendix 24 is preceded by an explanatory text on these matters.

4.5.12 Summary of the classification of formulation behaviour in the prefocus stage

For the purpose of describing the student informants’ formulation behaviour in the prefocus stage (cf. the first research question), I have elaborated a classification of ten characteristics. These have been presented one by one in section 4.5 above. As mentioned in the introductory part of this chapter, the variable *formulation behaviour* is very general compared with the other variables in this study, and this part of the analysis is more tentative than the rest of chapter 4. The set of characteristics was necessary for me to be able to describe patterns in the informants’ very heterogeneous and complex formulation behaviour. These characteristics might also be used in further explorations of information need formulation in the prefocus stage. The relationship between formulation behaviour and learning style will be presented in section 4.9.1, whereas the relation to PedNett user types will be presented in section 4.9.2. In section 4.10 (in figure 4.2) I will illustrate the overall patterns found for the variables in the empirical data, including characteristics of formulation behaviour.

4.6 Exemplification of PedNett user types and characteristics of formulation behaviour

The six categories of PedNett user types were introduced in section 4.2. In this section I will describe each of these user types exemplified by 6 specific informants, emphasizing how their term selection made me put them in each of the PedNett user type categories. I will call these presentations *examples*. I avoid the concept *prototypes*, as I want to avoid a discussion as to whether a prototype can contain non-typical features in addition to the typical ones. The data from the Revealment study is very complex, and for each of the six categories of PedNett user types I have established, there is no completely ‘pure’ prototype. I present typical representatives for each category, keeping in mind that all the informants exhibit some individual features. The contents of the 8 terminological steps for each of the informants presented in this section are provided as appendix 25.

The analysis of the 54 students involves a back-and-forth process between each individual student and the characteristics they exhibit on a group level. The PedNett user types instantiate potential applications of PedNett – as a *recognition tool* for search term candidates (cf. Applicator), as well as a trigger for the *activation of individual vocabulary* (cf. Reactivator), or both (cf. Combiner). PedNett is also applicable as an *idea generator for brainstorming* and structuring of a work task (Enricher – as well as the other three).

For each of the informants presented in the following sub-sections, I will provide a short definition of the PedNett user type, followed by demographic information about the informant, and self-reported evaluation of searching experience, terminological challenges, and prior knowledge of the given work task. I will then present how the specific PedNett user type is exemplified in the empirical data, to ‘get a better grip’ of each user type. The presentation of each informant will be wound up by pin-pointing which characteristics of formulation behaviour are found, i.e. examples of facet-embracing, phrasing, first-patching etc., which were listed in the classification in section 4.5. These characteristics do not exhibit a very clear picture in relation to PedNett user types, as the establishment of the six user types primarily has been made in relation to two other variables, i.e. number of terms (cf. 4.4.2) and degree of deep learning style (cf. 4.3.1). However, in line with the aim for my analysis, I want to include complexities and contradictions in the data (3.1.1). Accordingly I find it relevant to include a presentation of formulation characteristics in the exemplification of PedNett user types.

I want to present data from both the simulated work tasks which were used in the informant sessions (cf. appendices 15-16). Thus, in the demonstration of PedNett user types presented below, the Comprehensive school task is used in the examples of the user types Reactivator, Aloofer and Rejecter. The Motivation task is used in the examples of the user types Applicator, Combiner, and Enricher. Of the total sample of informants, 28 students worked on the Comprehensive school task, and 26 students worked on the Motivation task. The PedNett user types in the examples below are represented by 1 male student (the

Applicator) and 5 female students (i.e. the rest of the PedNett user types) – in the total sample, there were 40 female and 14 male students.

4.6.1 A typical PedNett *Applicator*

The *Applicator* PedNett user type applies PedNett terms in step 8 for the revised set of tentative search terms (cf. 4.2.1). This user type is attributed to 32 informants.

The informant exemplifying the Applicator type is a male student, 20 years, with 4-6 years of Internet experience, uses Google 1-2 times a week, library catalogues 1-2 times a month, and article databases 1-2 times a year. He has no previous studies in pedagogy. This student had not seen the work task before the informant session. He reports that he finds search term selection 'very easy' and rephrasing 'easy'. His main challenge in information searching is to 'find relevant information'. In searching, this informant prefers precision over recall in that he prefers a few very relevant documents rather than many partially relevant documents. This informant elaborated on the Motivation task in the informant session. For contents of steps 1-8, cf. appendix 25.

There are several characteristics of the Applicator user type found in this informant: He revises step 8 by adding several PedNett terms, e.g., *stadieteorier* 'theories of stages of cognitive development', *Piaget*, *sosiokulturell teori* 'sociocultural theory', and *Vygotskij*. Typically also, he adds several PedNett terms both in step 6 and step 7, so the revised set of tentative search terms in step 8 is made up of a sub-part of PedNett terms applied in steps 6-7. Using PedNett for enriching the structure in step 6 with PedNett terms applies to all PedNett user types except the Aloofer and the Rejecter.

This informant also demonstrates several characteristics of formulation behaviour (not related to the Applicator user type). This paragraph is presented for the reader to be able to recognize these characteristics in studying the contents of steps 1-8 (cf. appendix 25): He is rather *facet-trusting* in steps 1 to 4 to 5 in that he sticks rather close to the work task facet terms selected in step 1. Still, with the terms *læringsteorier* 'learning theories' and *motivasjonsfaktorer* 'motivation factors' he also demonstrates *self-production* as well as *narrowing*. The log of PedNett use shows that the informant visits 3 out of 5 work task facet terms, as well as several other related nodes. He uses the 'expand' function to reveal relationship descriptions at word level. This student reports that he considered the relationship descriptions as easy explanations for concepts for which he was uncertain about the definition.

4.6.2 A typical Term *Combiner*

The *Combiner* PedNett user type both reactivates terms from steps 1-5 as well as applies PedNett terms in step 8 (cf. 4.2.2). This user type is attributed to 6 informants.

The informant exemplifying the Combiner type is a female student, 24 years, with 7 years or more of Internet experience. She uses Google 1-2 times a month, library catalogues 1-2 times a year, never uses article databases. She has no previous studies in pedagogy. This student had not seen the work task before the informant session. This student reports that she finds search term selection neither easy nor difficult (‘neutral’), and rephrasing ‘easy’. Her main challenge in information searching is ‘find the right sources, select the best’. In searching, the informant prefers precision over recall in that she prefers a few very relevant documents rather than many partially relevant documents. This informant elaborated on the Motivation task in the informant session. For contents of steps 1-8, cf. appendix 25.

There are several characteristics of the Combiner user type found in this informant: She combines two strategies of PedNett use – as a Reactivator (of terms from steps 1-4), as well as an Applicator (of PedNett terms in step 8). She has a rich vocabulary, both in steps 2-3 (self-produced) and in steps 6-8 (PedNett terms as well as reactivated self-produced terms). This informant demonstrates the intention of PedNett, in that it activates individual conceptual frames by the mechanism of recognition. In step 8 she reactivates the work task facet term *undervisning* ‘teaching’(selected in step 1 but not used in step 5), as well as her self-produced term *attribusjonsteori* ‘attribution theory’ from steps 2-3. She also adds several terms in step 8 which are found in PedNett and applied already in steps 6-7, e.g., *didaktikk* ‘didactics’ and *pedagogikk* ‘pedagogy’. As all the categories except for the Aloofer and Rejecter types, this Combiner uses PedNett to enrich the structure in step 6 with PedNett terms.

This informant also demonstrates several characteristics of formulation behaviour (not related to the Combiner user type) – cf. appendix 25 for contents of the terminological steps: She is *facet-embracing* in that she selects extra many terms in step 1 (also the non-topical terms *drøft* ‘discuss’ and *betydning* ‘meaning’). She is *facet-trusting* from step 1 to steps 4 and 5, i.e. she sticks to work task facet terms. She demonstrates *removing* in step 6 when she removes the term *VAKT-prinsippet* ‘the principle of using Visual, Auditive, Kinaesthetic, and Tactile learning channels’ used in step 3. The log of PedNett use shows that the informant visits all work task facet terms, plus a few related terms. She shows a frequent use of the 'expand all' function. The informant reports that she conceives of the relationship descriptions as 'precise and easy supplementary information about concepts'.

4.6.3 A typical Term *Reactivator*

The *Reactivator* PedNett user type reactivates terms from steps 1-5 (work task facets or self-produced) and uses them in step 8 for the revised set of tentative search terms (cf. 4.2.3). This user type is attributed to 6 informants.

The informant exemplifying the Reactivator type is a female student, 23 years, with 7 years or more of Internet experience. She uses Google 1-2 times a week, library catalogues 1-2 times a month, and article databases 1-2 times a year. She has no previous studies in pedagogy. This informant had seen the work task before in the electronic learning platform Fronter. She reports that she finds search term selection and rephrasing neither easy nor difficult ('neutral'). Her main challenge in information searching is to 'find the right word and choose'. In searching, this informant prefers recall over precision in that she prefers many partially relevant documents rather than a few very relevant documents. This student elaborated on the Comprehensive school task in the informant session. For contents of steps 1-8, cf. appendix 25.

There are several characteristics of the Reactivator user type found in this informant. In step 8 – after having used PedNett – she selects terms which were already there in steps 1-4: She reactivates the work task facet terms *inkludering* 'inclusion' and *flerkulturell skole* 'multicultural school' which she selected in step 1, but did not use in step 5. As all the categories except for the Aloofer and Rejecter types, this Reactivator uses PedNett to enrich the structure in step 6 with PedNett terms. The informant reports that she used PedNett to see relationships and draw parallels in the work task.

This informant also demonstrates several characteristics of formulation behaviour (not related to the Reactivator user type) – cf. appendix 25 for contents of the terminological steps: She exhibits *first-patching* in selecting only *enhetsskolen* 'the comprehensive school' as a tentative search term in step 5, after having expressed her information need by 8 terms in step 4. She is *facet-trusting* to a certain extent from step 1 to step 4, but also adds self-produced terms. Step 8 is an example of *fastening* in that the informant sticks to original terms used in steps 1-5, and adds no PedNett terms. She demonstrates *adjusting* in that she changes the form of one of the terms (from *enhetsskolen* 'the comprehensive school' to *enhetsskole* 'comprehensive school', which is used in PedNett). The log of PedNett use shows that the informant visits 4 work task facet terms as well as the nodes *immigrasjon* ‘immigration’ and *lek* ‘play’. The informant reports that she only used the word nodes, which is confirmed by the log showing little use of ‘expand/expand all’ function. Accordingly, the informant has seen few relationship descriptions in PedNett.

4.6.4 A typical Structure *Enricher*

The *Enricher* PedNett user type enriches the structure in step 6 with a few PedNett terms (cf. 4.2.4). This user type is attributed to 7 informants.

The informant exemplifying the Enricher type is a female student, 24 years, with 4-6 years of Internet experience. She uses Google 1-2 times a week, library catalogues 1-2 times a year, and never uses article databases. She has no previous studies in pedagogy. This informant had seen the work task before in the electronic learning platform Fronter. She reports that she finds search term selection and rephrasing neither easy nor difficult (‘neutral’). Her main challenge in information searching is ‘to find which sources to search’. In searching, the informant prefers precision over recall in that she prefers a few very relevant documents rather than many partially relevant documents. This informant elaborated on the Motivation task in the informant session. The contents of the 8 terminological steps are listed in appendix 25.

There are several characteristics of the Enricher user type found in this informant: PedNett is used in step 6 to supplement the vocabulary in the structured brainstorm of the work task, e.g., with *didaktikk* ‘didactics’ and *klasseledelse* ‘class guidance’. Even though the informant adds some words from PedNett in step 7, she does not apply any of them in step 8. The only term added in step 8 is a repetition of one of the terms used in step 5. The informant has few terms both in step 5 and step 8, which is typical for the structure Enricher type.

This informant also demonstrates several characteristics of formulation behaviour (not related to the Enricher user type) – cf. appendix 25 for contents of the terminological steps: The use of *pedagogikk* ‘pedagogy’ in step 5 exemplifies *first-patching* in that the informant applies a more general term as a search task facet than what has been used in previous steps. The informant demonstrates *facet-trusting* from step 1 to step 4 (sticking to the work task facet terms *læring* ‘learning’, *undervisning* ‘teaching’, and *motivasjon* ‘motivation’). The term *Maslows behovshierarki* ‘Maslow's hierarchy of needs’ in step 7 demonstrates *self-production*, and hints that the student is skilled, as the term is not found in PedNett. *Læring* ‘learning’ in step 8 demonstrates *fastening* (sticks to original term from steps 1-5), as well as *final-patching* (ends up with one tentative search term). The log of PedNett use shows that the informant visits the work task facet terms and uses the ‘expand all’ function on each of them.

4.6.5 The only PedNett *Aloofer* informant

The *Aloofer* user type visits the PedNett database, but is aloof to applying terms, and makes only slight changes in steps 6 and/or 7 (cf. 4.2.5). This user type is attributed to only 1 informant, which is presented below.

The informant exemplifying the Aloofer type is a female student, 23 years, with 4-6 years of Internet experience. She uses Google daily, and never uses library catalogues or article databases. She has conducted an introductory university course in pedagogy. This student had not seen the work task before the informant session. The informant reports that she finds search term selection and rephrasing ‘easy’. Her main challenge in information searching is to ‘find documents which are credible and can be used as reliable sources’. In searching, the informant prefers precision over recall in that she prefers a few very relevant documents rather than many partially relevant documents. This informant elaborated on the Comprehensive school task in the informant session. For contents of steps 1-8, cf. appendix 25.

Let us now look at the characteristics which make me categorize this informant as an Aloofer type: She seems to be under little influence from PedNett. In step 6 she only adds one term, which she (according to the log) has seen in PedNett, i.e. the term *Mobbing* ‘bullying’, arrived at through the node *Toleranse* ‘tolerance’, which she uses in step 7 in citing the relationship description (*[Manglende] toleranse kan føre til mobbing* ‘Lacking tolerance can lead to bullying’). In step 7 she adds the self-produced term *flerkulturelt klasserom* ‘multicultural classroom’, which is not found in PedNett, neither as a word node, nor in a relationship description. She has misunderstood (or for some reason does not follow) the instructions in the questionnaire concerning steps 5 and 8: In step 5 she provides URLs for *Google* and *Wikipedia* instead of suggesting tentative search terms. Step 8 contains no PedNett terms, so PedNett is used slightly and only for structure enrichment (step 6), not for the production of tentative search terms. In step 8 she describes her intended search strategy (“Make a more specific search on concepts – find related concepts within the same category”, etc.) instead of providing a revised set of tentative search terms. The Aloofer intersects slightly with the Enricher user type, indicating a gradual difference between the two. They both apply PedNett terms in step 6; however the Aloofer adds only one single term, and thus represents the next-to-nothing-end of a continuum of PedNett use, only surpassed by the Rejecter.

This informant also demonstrates several characteristics of formulation behaviour (not related to the Aloofer user type) – cf. appendix 25 for contents of the terminological steps: She is *facet-embracing* in that she selects extra many terms in step 1 (also the non-topical terms *rede for* ‘account for’, *vurder* ‘assess’, *sammenheng* ‘relation’, and *drøft* ‘discuss’). She is *facet-trusting* from step 1 to step 4 – the only topical terms in step 4 are *enhetsskolen* ‘the comprehensive school’, *likhet* ‘likeness’, *likeverd* ‘equality’, and *inkludering* ‘inclusion’. In addition she uses a lot of non-topical terms concerning how she intends to handle the work task facets in the task (*definisjon* ‘definition’, *betydning* ‘meaning’, etc.). The informant exhibits *phrasing* throughout the task, in that she works at phrase or sentence level rather than at word level. The log of PedNett use shows that the informant visits work task facet terms, but also several other nodes (e.g., *lek* ‘play’ and *didaktiske modeller* ‘didactic models’). She uses the ‘expand’ function mostly on single words. The informant reports great satisfaction with PedNett, stating that she benefited both from word nodes and relationship descriptions, and says that she got inspiration find relevant aspects to add in the work task. She is remarkably positive in her evaluation of PedNett, considering that she hardly adds anything at all from the network.

4.6.6 An example of the PedNett *Rejecter* type

The *Rejecter* PedNett user type visits the PedNett database, but does not use any of the terms for revision of steps 6-8 (cf. 4.2.6). This user type is attributed to 2 informants (of which the description below is based on one of them), so the section heading does not state ‘typical’ for this category description.

The informant exemplifying the Rejecter type is a female student, 24 years, with 4-6 years of Internet experience. She uses Google daily, library catalogues 1-2 times a year, and never uses article databases. She has no previous studies in pedagogy. This student had not seen the work task before the informant session. She reports that she finds search term selection ‘easy’ and rephrasing neither easy nor difficult (‘neutral’). Her main challenge in information searching is to ‘find the right kind of information which is topically relevant’. In searching, the informant prefers precision over recall in that she prefers a few very relevant documents rather than many partially relevant documents. This informant elaborated on the

Comprehensive school task in the informant session. For contents of steps 1-8, cf. appendix 25.

I will now pin-point the characteristics which make me categorize this informant as a Rejecter type: She adds no new terms – neither self-produced nor PedNett-terms – in steps 6, 7 and 8. The topical vocabulary in steps 2-5 is made up by only work task facet term selected in step 1. In step 6 the informant only makes comments to her self-produced terms made in steps 2 and 3, adding ‘ok’, ‘is often mixed up’, etc. In step 7 she removes her step 4-notes on *enhetsskolen* ‘the comprehensive school’, *likhet* ‘likeness’, *likeverd* ‘equality’, and *inkludering* ‘inclusion’, and adds the title of a specific document (*LK06* ‘the National Curriculum for Knowledge Promotion 2006’). In step 8 she makes a note to herself to check what *LK06* states about *likhet*, *likeverd*, and *inkludering*. During steps 6-8, the informant adds neither PedNett terms nor self-produced terms, ending up with a search strategy of using one single document (i.e. *LK06*) as information source for the work task, looking up work task facet terms there.

This informant also demonstrates several characteristics of formulation behaviour (not related to the Rejecter user type) – cf. appendix 25 for contents of the terminological steps: She is *facet-trusting* in steps 1 to 4 to 5 in that she sticks close to the work task facet terms selected in step 1, the only other terms used being *LK06* and non-topical terms. She demonstrates *removing* in step 7 when she removes all previous notes except *LK06*. This builds up to a kind of *final-patching* in step 8 when the informant ends up with the search strategy of using only one specific document (*LK06*). This is a non-typical kind of *final-patching*, in that this search strategy usually refers to the situation when an informant end ups with one or very few *search term(s)* – not, as in this case, only one *document*. The log of PedNett use shows that the informant first visits work task facet terms, and then some of the terms produced in the brainstorm (e.g., *tilpasset opplæring* ‘adapted education’, *kulturell forståelse* ‘cultural understanding’, and *språk* ‘language’). This informant makes frequent use of the ‘expand all’ function. The informant expresses satisfaction with the method of working terminologically in a stepwise manner. She is also very positive to the usefulness of PedNett and the relationship descriptions, which is a bit surprising considering that she applies no PedNett terms – neither word nodes, nor parts of relationship descriptions.

4.6.7 Summary of exemplification of PedNett user types and characteristics of formulation behaviour

In section 4.6 I have described the six PedNett user types by presenting an example of an informant from each category, i.e. an Applicator, Combiner, Reactivator, Enricher, plus the only Aloofer, as well as one of the two Rejecters. For each of the examples I have also pointed out instantiations of formulation behaviours (facet-embracing, phrasing, first-patching, etc.), though these characteristics are not related to specific PedNett user types.

4.7 Patterns in the empirical data: Part 1. Learning style, number of terms, and PedNett user types

In the following four sections I will present patterns found in the empirical data. In sections 4.7-4.9 I will relate pairs of variables, followed by an integrating analysis at the end of each of these sections. Then, in section 4.10, I will present an overall model of patterns found in the empirical data, referred to as figure 4.2. As stated in section 1.6, I consider this as a qualitative study, and I do not intend to make statistical calculations apart from descriptive statistics. Thus, I have looked for emerging *patterns* in the empirical data. I conceive of these patterns as meaningful structures or themes to be subject for an analysis. This follows from my choice of method for the data collection.

I will refer to nodes and arrows in figure 4.2 (in section 4.10) during the analysis in sections 4.7-4.9. The nodes (black boxes in the figure) refer to variables in the empirical data, labelled with section numbers where they have been treated. There are six variables: PedNett user types (4.2), learning style (4.3.1), previous studies in pedagogy (4.3.2), prior knowledge of the assigned work task (4.3.3), number of terms (4.4.2), and formulation behaviour in the prefocus stage (4.5). The arrows between pairs of nodes in figure 4.2 refer to section numbers where the relationships between each pair of variables have been treated, i.e. sub-sections of 4.7-4.9. Since I have had a primary focus in the analysis on the variables learning style, number of terms, and PedNett user types, they will be treated in this first out of four sections reserved the patterns found in the empirical data.

4.7.1 Learning style in relation to number of terms

I found in section 4.3.1 that the *degree of deep learning style* is a productive way to sort the learning style variable, producing insightful patterns in the data. The deep learning style is related to the intention of acquiring a thorough understanding of the learning material. In my empirical data, there is a relationship between the degree of deep learning style and the number of terms used in steps 3, 5 and 8, as we will see in the present section. The degree of deep learning style is also related to PedNett user type (cf. section 4.7.3) and formulation behaviour (section 4.9.1). Based on the data which will be presented in this section, I claim that when students with a *high* degree of deep learning style select many terms from PedNett in step 8, they have already exhibited a large self-produced vocabulary on their own, both in step 3, and in step 5 – so students with a high degree of deep learning style seem to benefit more from PedNett as a semantic tool in the prefocus stage.

Deep learning style is related to number of terms in different ways for informants with a high, middle, or low *deep* score on the ASSIST test, as presented in the table below (cf. section 3.4.1.2 for my definition of high, middle, and low scores). We have to be aware, though, that the number of terms are results at a *group* level. There are huge differences between the individual informants within each group of high, middle, and low deep score, as the 'range' columns indicate. I have not made t-testing or other statistical calculations of the data, for reasons given in sections 1.6 and 3.1.2.

Deep score groups	*Mean number of terms in terminological step*					
	Step 3	*Range*	*Step 5*	*Range*	*Step 8*	*Range*
High score: 33-40 (19 informants)	11.3	4-25	4.00	0-7	4.4	1-12
Middle score: 29-32 (18 informants)	9.4	4-15	4.00	0-7	2.6	0-10
Low score: 8-28 (17 informants)	9.4	5-17	3.2	0-6	4.3	0-14
Mean value n=54	10	4-25	3.7	0-7	3.8	0-14

Table 4.6 Deep learning style in relation to number of terms in steps 3, 5, and 8. Grey cells support the conclusion in this sub-section that a high deep score caters for above mean number of terms in steps 3, 5, and 8.

Informants with a high *deep* score have a high frequency of self-produced terms in the structured brainstorm (step 3). In the tentative formulation of search terms (step 5), both middle and high *deep* score exhibit above mean number of terms. I interpret the terminological richness in steps 3 and 5 as an indication of a relationship between middle or high degree of deep learning style and a rich individual conceptual frame (i.e. a richer vocabulary at the outset of the work task, than students with a lower *deep* score).

In step 8 we note an interesting difference between the three score levels: Both high and low deep score exhibit above mean number of terms, whereas middle deep score have a low number of terms. There might be different reasons for the results for high and low deep score. If indeed a high deep score is related to richer individual conceptual frames, they are better able to select relevant terms from PedNett. For the group of low score (in which the informants have a low level of self-produced terms steps 3 and 5 and thus poorer frames), I interpret the above mean number of terms in step 8 to be due to a scattered PedNett term selection. They seem to be less founded in the students' current conceptual frames and are more of a guesswork – similar to Lönnqvist's (2003) information searcher type *hagelskytten* 'the shotgun shooter'.

If the same tendency were to be seen in a larger study – that both high and low score of deep learning style is related to an above mean number of PedNett terms selected in step 8 – it could lead to the following assumption: PedNett is useful for different types of searches depending on the degree of deep learning style (e.g., as an idea generator in exploratory searching, versus selection of search term candidates in searching for more pertinent information). However, in the context of this analysis I will confine myself to assumptions about the *high* deep score category. We can conclude that a high deep score caters for above mean number of terms in steps 3, 5, and 8 (indicated by grey cells in table 4.6 above). On a group level, the higher score of deep learning style, the richer vocabulary the students produce in steps 3 and 5, and the more PedNett terms they select in step 8. The relationship between learning style and number of terms is marked as arrow 4.7.1 in figure 4.2 (cf. section 4.10).

4.7.2 Number of terms in relation to PedNett user type

In the description of PedNett user types in relation to number of terms, I will include the user types Applicator, Combiner, Reactivator, and Enricher. Thus, the Aloofer and Rejecter types are left out, because they only concern 3 informants in total. The four PedNett user types under consideration relate to number of terms in steps 3, 5, and 8 in the following manner:

PedNett user type	*Mean number of terms in terminological step*		
	Step 3	*Step 5*	*Step 8*
Applicator	9.8	4.1	4.8
Combiner	9.8	4.7	6.5
Reactivator	12.5	2.7	2.0
Enricher	9.1	2.9	0.1
Mean value n=54	10	3.7	3.8

Table 4.7 Number of terms in steps 3, 5, and 8 relation to PedNett user type

We note that Applicators and Combiners are near the mean number of terms in step 3. They have above mean number of terms in step 5, and far above the mean number of terms in step 8, whereas the opposite is true for Reactivators and Enrichers. On a group level, the number of terms in step 5 relates to the number of terms in step 8 (above number of terms in step 5 [Applicator and Combiner] → above in step 8, and below in step 5 [Reactivator and Enricher] → below in step 8). The relationship between number of terms and PedNett user type is marked as arrow 4.7.2 in figure 4.2 (cf. section 4.10).

4.7.3 Learning style in relation to PedNett user type

In the description of PedNett user types in relation to learning style, I will include the user types Applicator, Combiner, Reactivator, and Enricher. These categories exhibit a continuum of increasing score on deep learning style, with Enricher as the lowest, then Reactivator, then Combiner, and – as the only one above the mean value of deep score – the Applicator type. On a group level, a deep score above mean value is related to Applicators, and accordingly the selection of PedNett terms in step 8.

PedNett user type	*Learning style* *Mean deep score*
Applicator	31.7 (above mean value)
Combiner	30.7 (≈ mean value)
Reactivator	29.5 (below)
Enricher	28.1 (far below)
Mean value n=54	30.7

Table 4.8 Learning style in relation to PedNett user type

We might say that informants with a high deep score use PedNett more extensively in step 8. Or the other way around, that those students who select PedNett terms in step 8 have a deep score above mean level. However, if we use the definitions of high (33-40), middle (29-32), and low (8-28) deep score as used in section 4.7.1, all the four PedNett categories in the table above end up with a middle degree of deep learning style. This will be commented on in the next sub-section, in which I look at all the three variables number of terms, learning style, and PedNett user type. The relationship between learning style and PedNett user type is marked as arrow 4.7.3 in figure 4.2 (cf. section 4.10).

4.7.4 Integrating the variables learning style, number of terms, and PedNett user type

In the previous sub-sections of 4.7, I have concluded with the following three interpretations concerning each pair of variables: *Learning style/Number of terms:* A high deep score caters for above mean number of terms in steps 3, 5, and 8. *Number of terms/PedNett user type:* The number of terms in step 5 relates to the number of terms in step 8 – Applicators and Combiners are above mean number of terms in steps 5 and 8, whereas Reactivators and Enricher are below. *Learning style/PedNett user type:* There is a continuum of increasing degree of deep learning style, from Enricher (as the lowest), to Reactivator, then Combiner, and (above the mean value of deep score), the Applicator type. In table 4.9 below, I have made a collocation of the three variables which I have explored so far in section 4.7.

Deep score *(numbers in this column refer to mean value of deep score)*	*Step 3*	*Step 5*	*Step 8*
	(numbers in these columns refer to number of terms)		
High score: 33-40 15 App: 36.0 2 Co: 36.5 1 Rea: 34 1 En: 33 *19 high deep: 35.8*	15 App: 10.9 2 Co: 6.0 1 Rea: 25.0 1 En: 15.0 *19 high deep: 11.3*	15 App: 4.1 2 Co: 6.0 1 Rea: 0 1 En: 3.0 *19 high deep: 4.0*	15 App: 4.9 2 Co: 4.0 1 Rea: 2.0 1 En: 1.0 *19 high deep: 4.4*
Middle score: 29-32 8 App: 30.5 1 Co: 32.0 3 Rea: 30.0 3 En: 30.3 1 Alo: 29.0 2 Rej: 29.5 *18 middle deep:30.3*	8 App: 9.1 1 Co: 10.0 3 Rea: 9.7 3 En: 8.7 1 Alo: 13.0 2 Rej: 9.0 *18 middle deep: 9.4*	8 App: 4.4 1 Co: 3.0 3 Rea: 5.0 3 En: 3.7 1 Alo: 0 2 Rej: 4.0 *18 middle deep: 4.0*	8 App: 4.8 1 Co:3.0 3 Rea: 2.0 3 En: 0 1 Alo: 0 2 Rej: 0 *18 middle deep: 2.6*
Low score: 8-28 9 App: 25.4 3 Co: 26.3 2 Rea: 26.5 3 En: 24.3 *17 low deep: 25.5*	9 App: 8.7 3 Co: 12.3 2 Rea: 10.5 3 En: 7.7 *17 low deep: 9.4*	9 App: 3.8 3 Co: 4.3 2 Rea: 0.5 3 En: 2.0 *17 low deep:3.2*	9 App: 4.6 3 Co: 9.3 2 Rea: 2.0 3 En: 0 *17 low deep: 4.3*
All degrees of deep 32 App: 31.7 6 Co: 30.7 6 Rea: 29.5 7 En: 28.1 1 Alo: 29.0 2 Rej: 29.5 *n=54: 30.7*	32 App: 9.8 6 Co: 9.8 6 Rea: 12.5 7 En: 9.1 1 Alo: 13 2 Rej: 9.0 *n=54: 10*	32 App: 4.1 6 Co: 4.7 6 Rea: 2.7 7 En: 2.9 1 Alo: 0 2 Rej: 4.0 *n=54: 3.7*	32 App: 4.8 6 Co: 6.5 6 Rea: 2.0 7 En: 0.1 1 Alo: 0 2 Rej: 0 *n=54: 3.8*

Table 4.9 Integrating deep learning style, number of terms, and PedNett user type

Let us now consider each of the statements concerning the pairs of variables above, in light of the third variable: *Learning style/Number of terms – PedNett user type: "*A high deep score caters for above mean number of terms in steps 3, 5, and 8". We now read the first ('high score') row of the table, and concentrate on the cells for steps 3, 5, and 8. If we relate the statement about learning style and number of terms to PedNett user types, we note that there are large differences between the PedNett user types with a high deep score, i.e. Applicator, Combiner, Reactivator, and Enricher. Only the Applicators have an above mean number of terms in all the three steps 3, 5, and 8 (cf. light grey cells in the row for high deep score).

Number of terms/PedNett user type –Learning style: "The number of terms in step 5 relates to the number of terms in step 8 – Applicators and Combiners are above mean number of terms in steps 5 and 8, whereas Reactivators and Enricher are below". We now focus on the columns for steps 5 and 8 in the table. If we relate the statement about number of terms and PedNett user type to the degree of deep learning style, we note that Applicators are above the mean number of terms in all levels of deep score (high/middle/low), in both step 5 and step 8 (cf. light grey cells in the columns for steps 5 and 8 below). The Combiners have an above mean number of terms for high and low deep score in steps 5 and 8 (cf. dark grey cells), but (the only) Combiner with a middle deep score is below. In this paragraph I have confined myself to comment on only the two user types with high number of terms, i.e. Applicators and Combiners.

Learning style/PedNett user type – Number of terms: "There is a continuum of increasing degree of deep learning style, from Enricher (as the lowest), to Reactivator, then Combiner, and (above the mean value of deep score), the Applicator type". Let us first look at the left-most column of table 4.9 above, displaying scores of deep learning style distributed on PedNett user groups for each group of high/middle/low deep score. The left bottom corner presents the deep score for the total sample as well as the score for each user group, i.e. the numbers which support the statement above. If we consider the three cells above (i.e. the rest of the left-most column), we note that Combiners have a higher deep score than Applicators in all the three levels of high/middle/low deep score, and that both Combiners and Applicators in the high deep score group have an above mean deep score. When Applicators have the highest deep score across the degrees of deep score, it is because this is by far the largest PedNett user group, and most of its group members are in the 'high deep score' category – whereas half of the Combiners are in the 'low deep score' category. The statement above is thus only relevant when we consider the PedNett user groups across the high/middle/low deep score categories.

Let us now look at the bottom row of table 4.9, displaying scores of number of terms distributed on PedNett user groups for each of the steps 3, 5, and 8. We note that Applicators and Combiners are near the mean number of terms in step 3, and above the mean number of terms in steps 5 and 8. Combiners in particular, have a high number of terms in step 8. If we compare the Reactivators and Enrichers in step 3, we note that Reactivators have a number of terms far above the mean number of terms in step 3, whereas Enrichers are below. In steps 5 and 8, these two user groups are both below the mean numbers. However, whereas the Enrichers do not add any PedNett terms in step 8, the Reactivators select terms used in steps 1-5 and reactivate them in step 8 for the revised set of tentative search terms – which of course comes with the definitions of these PedNett user types. What I find interesting is the relatively large number of self-produced terms in step 3 for Reactivators, and the fact that these informants only use their own terms in step 8. When these students recognize terms in PedNett and add them in step 8, these terms have already occurred in their rich brainstorms. So the effect of recognition is there, but in the case of Reactivators, they have been able to retrieve a larger set of terms prior to PedNett use.

We see that PedNett is used for different purposes – revision of structured brainstorm, reactivation of self-produced terms from previous steps, and recognition of search term candidates. These findings can be used in system design for semantic tools like PedNett. The rich set of unique associative relationships provides the users with a different kind of input than what we find in standard thesauri based on hierarchical relationships – cf. the presentation in section 1.2.3 of Bates' (1986) proposal of an end-user thesaurus. PedNett provides a vocabulary which is in-between the vocabulary of the users and the terminology found in documents in the topical area of pedagogy. This feature points towards using a tool like PedNett as a bridge between the users and the potentially relevant documents.

Instead of asking which of the PedNett user types benefits most from PedNett use, I would rather summarize which different uses each type exhibit: The Applicators primarily use PedNett to recognize relevant search terms in step 8. Combiners do the same, but they also reactivate their own terms from previous steps. Reactivators lend themselves on reactivating their self-produced terms (or work task facet terms provided in step 1), whereas Enrichers do not revise step 8, but rather use PedNett to revise the structured brainstorm in step 3. The Aloofer is reluctant in PedNett use, and the two Rejecters do not use PedNett for anything specific.

In addition to reminding ourselves of the huge differences we see on the individual level, we also have to remember that there are many other factors influencing the variables studied in section 4.7. In particular, number of terms are not only influenced by learning style, but also previous studies in pedagogy (cf. section 4.9.1) and prior knowledge of the assigned work task (cf. section 4.9.2). In figure 4.2 in section 4.10, the factors influencing number of terms are summarized by the following statements: Step 3 above mean number of terms primarily comes with prior knowledge of the assigned work task (i.e. students who have already made an outline), but is also related to students having performed previous studies in pedagogy, or students with a high degree of deep learning style. Step 5 above mean number of terms primarily comes with students who have already made an outline of the work task, but also with students who have a high degree of deep learning style. Step 8 above mean number of terms is either related to students with a high degree of deep learning style, or to

Applicators and Combiners, irrespective of deep score (but this last point comes as a consequence of the definition of the PedNett user types).

4.8 Patterns in the empirical data: Part 2. Previous studies in pedagogy and prior knowledge of the assigned work task

In this section I will present two of the three variables related to the number of terms in steps 3, 5, and 8, i.e. previous studies in pedagogy and prior knowledge of the assigned work task. The third variable related to term numbers is learning style, which was presented in section 4.7.1.

4.8.1 Previous studies in pedagogy in relation to number of terms

We saw in section 4.3.2 that 8 students had conducted previous studies in pedagogy, varying in length from introductory courses to one-year studies. These students exhibit a number of terms in step 3 (brainstorm) at 13.1. This is above the mean number for the sample, which is 10. For step 5 (tentative search term formulation), the students who had conducted previous studies in pedagogy had a term production (3.6) so close to the mean value for the total number of informants (3.7) that I can read nothing out of it. When it comes to PedNett term selection in step 8 (formulation revision), the students with prior pedagogical studies had a mean number of 2.6, which is *below* the mean number for the total number of informants (3.8). As stated in section 4.4.2, I will not dwell on number of terms in step 6, because it varies a lot between the work tasks, due to differences in PedNett associations related to the two sets of work task facet terms.

In sum, there is a relationship between previous studies in pedagogy and the number of self-produced terms in the structured brainstorm prior to PedNett use (i.e. step 3). In the last paragraph of section 4.7.4, this was discussed together with two other variables influencing number of terms (i.e. degree of deep learning style, and prior knowledge of the assigned work task). The relationship between previous studies in pedagogy and number of terms is marked as arrow 4.8.1 in figure 4.2 (cf. section 4.10). I found no relationships between previous studies and pedagogy and any of the other variables in the empirical data.

4.8.2 Prior knowledge of the assigned work task in relation to number of terms

We saw in section 4.3.3 that 20 students had seen the assigned work task before – respectively in the electronic learning platform Fronter (15), in class (3, one of them had seen the task in Fronter as well), or having made an outline (3, all of them on the Motivation task). Just having seen the work task in Fronter or in class – without having elaborated on the work task terminologically – does not seem to have any influence on number of terms, neither prior to PedNett use (steps 3 and 5) or during PedNett use (steps 6 and 8). The mean number of terms in these steps for the 20 students are all close to the mean values for total sample (with mean values for the total sample in parenthesis): step 3 had 10.2 (vs. 10), step 5 had 3.65 (vs. 3.74), step 6 had 9.55 (vs. 10.98), and step 8 had 3.9 (vs. 3.78) – here I have used two decimals to indicate the small discrepancies between the values.

However, if we concentrate on the 3 students who had made an outline for the Motivation task at some point before the informant session, we find a relationship between self-production of terms and prior terminological engagement with the work task. These students exhibited a production of number of terms *far* above the mean value in the terminological steps prior to PedNett use: step 3 had a mean value of 14.67 terms for the 3 students (as opposed to 10 for the total sample), and step 5 had 5.33 terms (vs. 3.74 for the sample). With PedNett use, step 6 had a mean value of 8.5 (as opposed to 10.98 for the sample), and step 8 had 6.5 terms (vs. 3.78 for the sample).

This large degree of self-production indicates that the students' individual conceptual frames had already been activated prior to the informant session due to their terminological engagement in the work task. (PedNett use is aimed at enhancing a similar activation of individual conceptual frames). However, this prior engagement does not seem to have a consistent influence on PedNett use in later terminological steps. Concerning the 3 informants who had made an outline for the work task before, the data shows that they select respectively none, on average, and far above the mean number of PedNett terms for total sample of informants in step 8 (formulation revision). The one student with no PedNett terms in step 8 was categorized as Enricher, and exhibited fastening. The two others were Applicators.

When it comes to step 6 (structure revision), previous work task outline elaboration relates to a number of terms far *below* the mean value for the total sample. These 3 informants all worked on the Motivation task, for which PedNett had a much higher number of associations to the work task facets than for the Comprehensive school task. So it seems that prior terminological engagement in the work task relates to a restrictive selection of PedNett terms during structure revision.

To sum up, prior knowledge of the assigned work task (in the meaning having made an outline of the task) relates to a very high number of self-produced terms prior to PedNett use (i.e. in steps 3 and 5). In the last paragraph of section 4.7.4, this was discussed together with two other variables influencing number of terms (i.e. degree of deep learning style, and previous studies in pedagogy). The relationship between prior knowledge of the assigned work task and number of terms is marked as arrow 4.8.2 in figure 4.2 (cf. section 4.10). I found no relationships between previous work task knowledge (seen in Fronter, in class, or made an outline) and any of the other variables of the empirical data, e.g., learning style or PedNett user type.

Concerning step 3, we saw a similar relationship between previous studies in pedagogy and number of terms (cf. section 4.8.1), i.e. previous pedagogy studies relates to number of terms *above* the mean number. However, with the relationship between previous work task knowledge and number of terms, the number of terms in steps 3 are *far above* the mean number for total sample – and in addition, we find the same for step 5. So previous work task knowledge has a stronger effect on self-production of terms than previous studies in pedagogy.

4.8.3 Integrating the variables previous studies in pedagogy, knowledge of the assigned work task, and number of terms

Number of terms in steps 3, 5, and 8 are influenced by three variables, i.e. degree of deep learning style (cf. section 4.7.1), previous studies in pedagogy, and prior knowledge of the assigned work task. In section 4.8 I have explored the latter two variables. Students, who have conducted previous studies in pedagogy, produce more terms in the structured brainstorm (step 3). However, prior knowledge of the assigned work task has a much larger impact on number of terms, in that it relates to a very high self-production of terms in steps 3 and 5. This is considered to be due to these students' previous terminological engagement in the work task.

4.9 Patterns in the empirical data: Part 3. Learning style, formulation behaviour, and PedNett user type

The variable *formulation behaviour* exhibits rather complicated patterns, both with respect to learning style, and in relation to PedNett user types, as will be demonstrated in this section.

4.9.1 Learning style in relation to formulation behaviour in the prefocus stage

In analysing the relationship between learning style and prefocus formulation behaviour, we have to remember that degree of deep learning style relates to individual informants, whereas each informant exhibits several of the ten characteristics of formulation behaviour. Table 4.10 below displays these characteristics in order of decreasing degree of deep learning style:

Formulation behaviours	*Number of informants exhibiting each formulation behaviour*	*Mean deep score*
Narrowing	8 inf.	32.8
Removing	11 inf.	32.8
Phrasing	6 inf.	32.0
Self-production	31 inf.	31.2
Facet-trusting	45 inf.	31.0
First-patching	10 inf.	30.4
Facet-embracing	14 inf.	29.8
Fastening	9 inf.	29.7
Adjusting	3 inf.	29.3
Final-patching	5 inf.	28.2
	n=54	*30.7*

Table 4.10 Degree of deep learning style in relation to formulation behaviour

The thick line between facet-trusting and first-patching, indicates the division between formulation behaviours related to deep scores *above* versus *below* the mean score for total sample, which is 30.7. The three grey areas indicate groups of formulation behaviours which are related to deep learning style *above* (light grey), *around* (medium grey), and *below* (dark grey) mean value, respectively. The relationship between learning style and formulation behaviour is marked as arrow 4.9.1 (plus the triangle below) in figure 4.2, cf. section 4.10. Relationships between pairs of formulation behaviours (e.g., the strong relationships phrasing→facet-embracing and fastening→first-patching) is described and illustrated in appendix 24.

4.9.2 Formulation behaviour in the prefocus stage in relation to PedNett user type

Table 4.11 below displays each of the ten characteristics of prefocus formulation behaviours and how these are distributed in relation to PedNett user types. We have to remind ourselves that the variable PedNett user type relates to individual informants, whereas each informant exhibits several of the ten characteristics of formulation behaviour:

Formulation behaviours	*Number of inf. for each form. behav.*	*Number of informants within each PedNett user type who exhibit each characteristic of formulation behaviour (number and percentage of n=54 provided with each user type)*					
		Applica-tor (32 inf.) 59 %	*Combi-ner (6 inf.) 11 %*	*Reacti-vator (6 inf.) 11 %*	*Enricher (7 inf.) 13 %*	*Aloofer (1 inf.) 2 %*	*Rejecter (2 inf.) 4 %*
Narrowing	8 inf.	6	1	1	0	0	0
Removing	11 inf.	4	3	2	1	0	1
Phrasing	6 inf.	1	1	2	1	1	0
Self-production	31 inf.	21	4	1	4	0	1
Facet-trusting	45 inf.	27	4	6	6	1	1
First-patching	10 inf.	4	0	1	4	0	1
Facet-embracing	14 inf.	6	4	2	1	1	0
Fastening	9 inf.	0	0	2	5	0	2
Adjusting	3 inf.	1	1	1	0	0	0
Final-patching	5 inf.	0	0	2	3	0	0

Table 4.11 Formulation behaviour in relation to PedNett user type

Let us consider the grey cells in the table above. A grey cell means that a PedNett user type exhibits a larger amount of a certain formulation behaviour than the user type’s share of the total sample indicates. We see that Combiners have a large share of removing and facet-embracing, whereas Enrichers have a large share of final-patching, fastening, and first-patching. Reactivators also have a large share of final-patching. We also note that no Applicators exhibit fastening or final-patching. The distribution for narrowing, self-production, and facet-trusting on PedNett user types are rather close to the user types’ shares of the total sample, thus they have no grey cells. I have also left out phrasing and adjusting, because they are small categories with no characteristic distribution. The relationships between formulation behaviours and PedNett user types are marked as several arrows labelled 4.9.2 in figure 4.2 (cf. section 4.10).

4.9.3 Integrating the variables learning style, formulation behaviour, and PedNett user type

We have seen in the two previous sub-sections of 4.9 that formulation behaviour exhibit rather complicated patterns both with respect to learning style and PedNett user type. This is related to the fact that the establishment of the variables learning style and PedNett user type primarily has been made in relation to another variable, i.e. number of terms. However, we do note that a high degree of *deep* learning style relates to the formulation behaviours narrowing (selection of more specific terms) and removing (fewer terms in step 8 than in step 5). I interpret this as an ability to single out aspects which are not given priority in later steps of the work task, as well as focusing the topic.

I have also illustrated how the ten formulation behaviours are distributed in relation to the six PedNett user types. Some user types exhibit a larger amount of a given formulation behaviour than the user type's share of the total sample would indicate. This is to a certain extent related to characteristics of the user type – e.g., when the Enrichers exhibit a large share of first-patching and fastening.

4.10 Summary of patterns found in the empirical data

In sections 4.7-4.9 I have presented patterns found in the empirical data. I have aimed at describing both the complexity and pin-pointing emerging patters. These are illustrated in figure 4.2 below. The nodes (black boxes in the figure) refer to variables in the empirical data, labelled with section numbers for where they have been treated: PedNett user types (4.2), learning style (4.3.1), previous studies in pedagogy (4.3.2), prior knowledge of the assigned work task (4.3.3), number of terms (4.4.2), and formulation behaviour in the prefocus stage (4.5). The arrows between pairs of nodes in figure 4.2 refer to section numbers where the relationships between each pair of variables have been treated, i.e. in sub-sections of 4.7-4.9.

We note that not all possible combinations of pairs of variables are explored in the analysis or indicated in the figure. E.g., there is no arrow relating the nodes number of terms and formulation behaviour. Neither of these two variables categorizes the unit of informants, which I find to be a prerequisite in pairing variables – all the other pairs have a least one of the variables categorizing informants. All the arrows are unidirectional, starting in the nodes for learning style, previous studies in pedagogy, and prior knowledge of the assigned work task – which are the three of which we have information about the informants before they started elaborating on the 8 terminological steps.

We have to keep in mind that there are variables outside this empirical study which also affect students' prefocus formulation behaviour, e.g., personality, IQ and grades in the topical area. These factors are not included in the present study, and are thus outside the scope of the present analysis. In sections 4.12-4.14 I will co-ordinate the results from my analysis in light of the three research questions, focusing on the relationships between the three variables presented in section 4.7 (i.e. degree of deep learning style, number of terms, and PedNett user types). Figure 4.2 below contains an overall model of patterns found in the empirical data, cf. the following two pages:

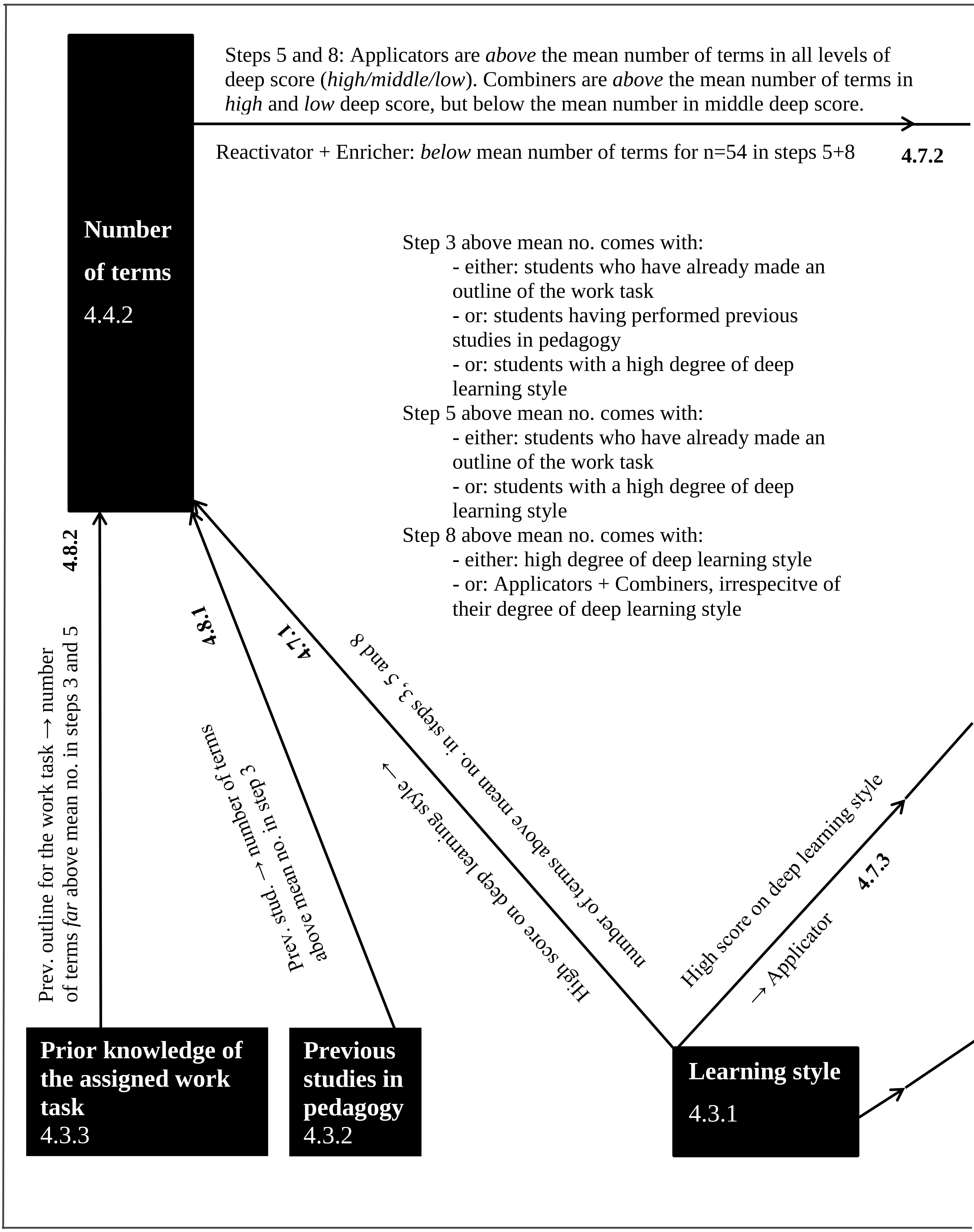
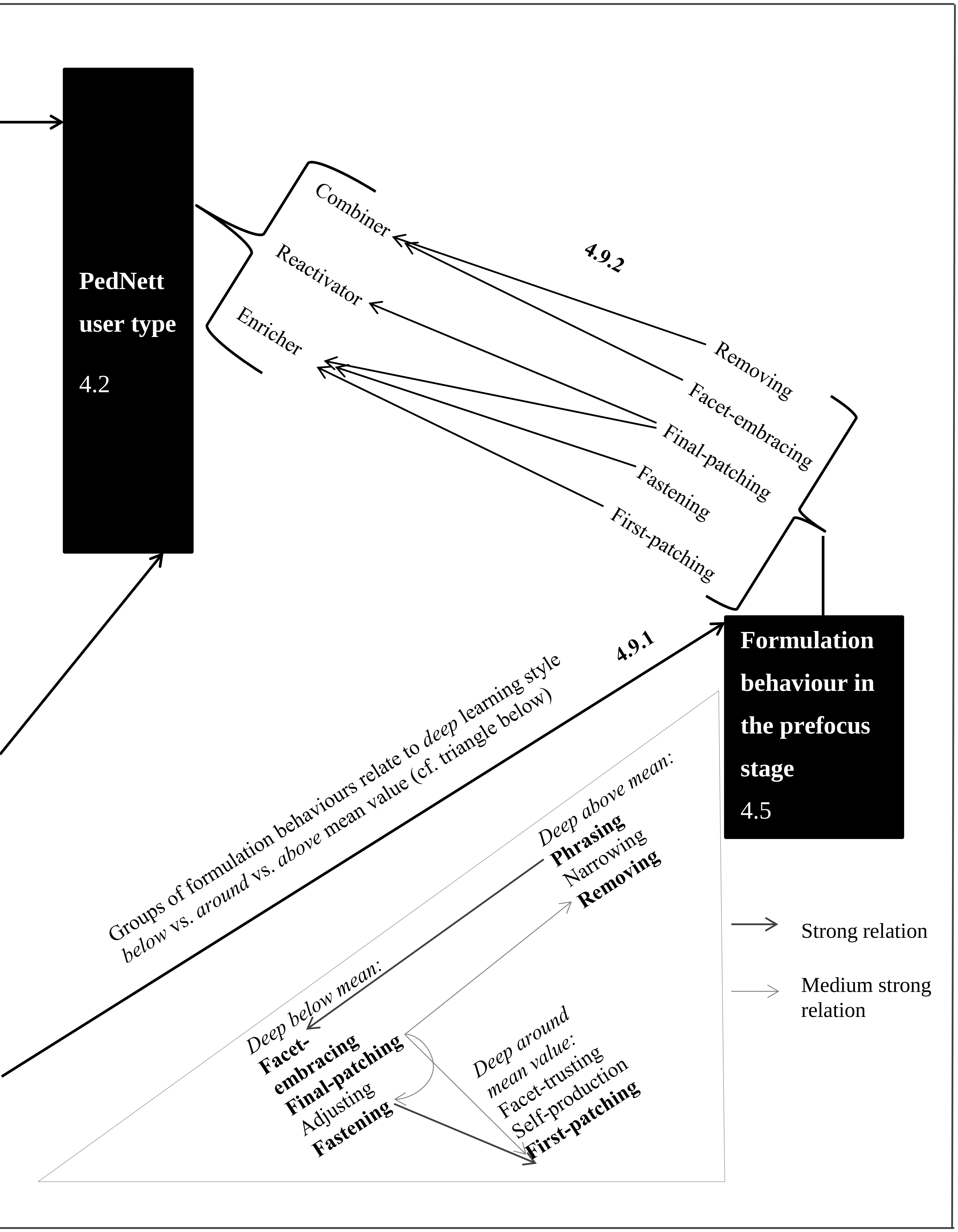


Figure 4.2 Overall model of patterns found in the empirical data (model covering 2 pages)



Continutation of figure 4.2 with patterns found in the empirical data (model covering 2 pages)

4.11 End-of-session information from the main questionnaire

In this section I will present the analysis of the information collected in the end-of-session part of the main questionnaire (cf. pp. 10-15 in appendix 13, translated in appendix 14). This part of the analysis is less detailed than the analysis of the terminological steps, because I wanted to have an emphasis on how the students actually *used* PedNett, rather than what they reported afterwards. In the end-of-session questionnaire I asked the students about how they experience work task and search task challenges, and for which work/search task operations they would find PedNett potentially useful. I have also asked the students about their opinions of PedNett functionality.

4.11.1 Work task challenges and students' perception of PedNett usefulness

In this sub-section I will present the information collected in the *first* part of the end-of-session questionnaire (cf. pages 10-11 of appendix 13, with translation in appendix 14). I first provided a list of work task related techniques, paralleling the terminological steps the students just had worked with. I asked the students which of these techniques they usually perform when working on an assignment.

Most of the students answered that they always make a selection of work task facets, brainstorming, and selection of information source (Internet, library database, etc.). 19 % of the students make a written clarification of information need, whereas only 1 student (i.e. 2 %) makes a written preparation of the formulation of search terms. There are no obvious patterns between learning style and PedNett user groups on these matters, apart from the only student who makes a written search preparation, who has got a high degree of deep learning style (deep score 37). 68 % of the students use mind-mapping technique always or sometimes. 15 % of the students have discussion groups with co-students, whereas 11 % mention use of course curriculum.

The students report a large variation both with respect to which of the work task techniques they use, and in which order. When asked what the next thing they would do after having performed the techniques mentioned above, 53 % select 'make an outline', 35 % select 'perform information search', whereas 12 % select 'start writing'.

In the next question I asked the students whether they found it useful to elaborate a work task in a set of terminological steps as they did in the main part of the informant session (cf. question (h) on the top of page 11 in the questionnaire). This was an open-ended question. Some of the students' answers were – paraphrased and translated by me: "The positive thing about PedNett was that it helped me with the brainstorming. I got many new ideas for perspectives I could use in the work task. I think it was good to see relationships which I would not have come up with by myself. Working more with the words made it easier to create an overview over how I could make an outline for the work task". The students' answers were also related to information need formulation and search term selection: "I think it was useful to have more time for preparations. I can get a more varied vocabulary. PedNett can guide me to what I am searching for. It was useful to get explanations for words and relationships between words. To find out what a word means. Definitions of words. A nice tool to recognize terms which are related. I would not have come up with all the perspectives/topics without PedNett". All the answers were positive. This is not surprising, since informants often want to adhere to the researcher's expectations. Because of this, I give preference to the observations of what the students actually *did* during the elaboration of the 8 terminological steps – rather than what they reported in the end-of-session questionnaire.

Answers like "PedNett provides definitions of words" and "there is a lack of concrete definitions" brings to light that several students expected PedNett to contain definitions. This was despite the information provided in the informant session that PedNett is neither an encyclopedia nor a dictionary, but an associative network which is meant as a help for students to come up with search term candidates. We saw in section 3.3.4 that the teacher informants also found it difficult to 'get the grip' of what relationship descriptions are. Based on how both the students and the teachers responded to the concept of relationship descriptions, I find that it would have been favourable to include definitions in the compilation of semantic tools like PedNett. I will provide further reflections on this matter in section 4.15 concerning shortcomings in the research design.

In the next question I asked the students what they experienced as the greatest challenges related to making a good assignment (cf. questions (i-j) on page 11 in the questionnaire). The students indicated their answers on a continuum from easy to difficult. I have checked whether there is a relationship between degree of deep learning style and the students' perceived work task challenges, without finding any such relationship. In the analysis presented in the table below I have collapsed the answers into two 'bulks', i.e. 'the easy end' of the continuum, and 'the difficult end'. Table 4.12 presents which *work task* challenges the students found most difficult or easiest, and whether they considered PedNett as a useful tool in that respect:

WORK TASK CHALLENGE	*PedNett was useful*	*PedNett was not very useful*
Difficult	Relate different pedagogic terms in a new and meaningful way. Elucidate how pedagogic concepts can be interpreted in several ways.	Narrowing the focus of the work task – find my own perspective.
Easy	Come up with perspectives/factors which can be related to the work task facets. Find specialized literature which can supplement the curriculum.	Clarify the main work task facets. Apply the obtained specialized literature in the work task at hand.

Table 4.12 Work task challenges and students' perception of PedNett usefulness

Let us have a look at which work task challenges the students found difficult. The first challenge was to relate different pedagogic terms in a new and meaningful way. This matches the intention of the word associations in PedNett – to provide the students with meaningful connections within the topical area of pedagogy. The second challenge was to elucidate how pedagogic concepts can be interpreted in several ways. This matches the intention of the relationship descriptions in PedNett. The students reported that they found PedNett useful for these two challenges. Furthermore, they reported the difficulty of narrowing the focus of their work tasks and find their own perspective. As we see in table 4.12 above, the students did *not* find PedNett useful with respect to this challenge.

Considering the nature of PedNett, that 'every word can potentially be associated to any word' in the network, we can conclude that this tool is better suited in the prefocus stage of information-based work tasks, and for exploratory searching – as a brainstorming tool and an idea generator for tentative search terms. Other semantic tools (e.g., searching thesauri) would be better suited in later stages of a work task, when the students have selected a focus and are searching for pertinent information on their topic.

4.11.2 Search task challenges and students' perception of PedNett usefulness

In this sub-section I will present the information collected in the *middle* part of the end-of-session questionnaire (cf. questions (k-l) on page 12 of appendix 13, with translation in appendix 14). I asked the students what they experienced as the greatest challenges related to information searching for specialized literature which can supplement their curriculum. Table

4.13 below presents which *search task* challenges the students found most difficult or easiest, and whether they considered PedNett as a useful tool in that respect:

SEARCH TASK CHALLENGE	*PedNett was useful*	*PedNett was not very useful*
Difficult	Come up with related terms (RT) which can be used in information searching on the topic of the work task. Come up with more precise/narrower terms (NT). Come up with more general/broader terms (BT).	Remember the English equivalent of a Norwegian term, or the other way around. Evaluate information quality and find high-quality/peer reviewed specialized literature when I am searching.
Easy	Come up with synonyms/words with a similar meaning. Find out for which topics you need to obtain specialized literature (initial information need formulation). Find out which terms you would like to use as search terms (query formulation). Come up with new search terms if you get no relevant results (reformulate query).	Find out which sources I should use to search for specialized literature (the Internet/library databases/other sources). Find out how I can perform a search with several search terms.

Table 4.13 Search task challenges and students' perception of PedNett usefulness

As with the work task challenges described in the previous section, I have checked whether there is a relationship between degree of deep learning style and the students' perceived search task challenges, but I find no such relationship. If we focus on what the students found most difficult and at the same time for which PedNett was potentially useful (cf. grey cell), we see that the students found that PedNett helps them in coming up with related terms, as well as narrower and broader terms, which can be used in information searching on the topic of the work task. In the left bottom corner ('easy challenge, PedNett useful) we also note that the students found PedNett useful to find out for which topics they need to obtain specialized literature, as well as query formulation and reformulation.

4.11.3 Students' opinions of PedNett functionality

In this sub-section I will present the information collected in the *last* part of the end-of-session questionnaire (cf. pages 13-15 of appendix 13, with translation in appendix 14).

The students were asked whether they had received any training in searching skills for Internet use or library databases. 54 % reported that they had conducted Internet search training, whereas 69 % had received some library search instruction (cf. question (m)). During the informant session, I reminded the students when they had 15 minutes left of the one-hour session, and told them to start on the end-of-session questionnaire if they had not done so yet. 43 % of the students reported that they had to interrupt their PedNett session (cf. question (n)). None of the students had any error messages on their computer during the session (question (o)).

I wanted to know whether the students made use of both the PedNett terms, as well as the relationship descriptions (cf. question (p)), and in what way the utilized the network. Many students answer that they found PedNett useful for recognizing relationships between topics and find relevant pedagogic terminology. "PedNett is very useful for brainstorming – I get more perspectives". They report that PedNett was well arranged and easy to use. "It would have been nice to use this kind of database in writing assignments".

More specifically, concerning the relationship descriptions, the students write that the descriptions gave a context to the PedNett terms, and that they benefited from them. They were positive to the arrow in front of each description, indicating in which direction the word association had been made. "Without the arrows and the added information [i.e. the relationship descriptions], PedNett would have been less useful". "The explanations by the arrows elaborate the concepts and explain the relationships between them, which I needed several times". "It was super to get more perspectives and ideas for my work task. I am often too narrow-minded". There were also some negative comments on the relationship descriptions, like: "The explanations were too meagre", and "some of the explanations were confusing or unclear in relation to my existing understanding of the concept". Some students had not understood the 'expand function', and thus had only used the PedNett terms.

Next, the students were asked for which purpose they used the relationship descriptions (cf. question (q)). 78 % said that they used them to check if the descriptions contained pedagogic terms which they could use in their work task. 70 % used the relationship descriptions to check their understanding of the PedNett term which was described, whereas 65 % reported that they used the descriptions to find out in which way the PedNett term described were related to the PedNett entry term of the PedNett cluster they had entered.

87 % of the students found it useful to have several relationship descriptions for a PedNett term (cf. question (r) p. 14), commenting that it helped them in considering several perspectives of a topic. In answering the next question (cf. question (s)), whether it was an advantage that the most frequently associated PedNett terms within a cluster were listed first, 35 % answer yes, others say that it could just as well have been alphabetically, and many of the informants had no opinion about it because they had not paid attention to this feature.

Finally, I opened up for any opinions the students might have concerning PedNett, which they had not expressed earlier in the end-of-session questionnaire (cf. question (t)). The positive comments were of the same kind as expressed by other informants in question (q), e.g., that PedNett was easy to use, and that it contained many useful concepts. “It was very good to be presented with related terms. This makes it easier for me in writing assignments, to get inspiration for more factors which can be useful to include.” The negative responses were mostly related to flaws in PedNett’s functionality or contents which are related to the fact that this is only a first version of this kind of a data-based semantic network. “There were too many words on the PedNett home page – there should have been an index of some kind, or a search function”. “The layout should be improved.” Some students comment that PedNett should have been more consistent with respect to dimensions and type of content. “The descriptions should be more extensive and contain more specialized terminology. I would have liked there to be URLs for relevant Internet pages and references to special literature”. These are not surprising comments – as we saw in section 3.3.3 on the nature of the relationship descriptions provided by the teachers, they indeed varied a lot.

On the last page of the questionnaire, the students were invited to use PedNett for coming occasions, as a source for ideas concerning pedagogic terminology when working on assignments. They were provided with a password for this purpose, as well as a list of the terminological steps they had been working on, in case they wanted to work in a similar manner with up-coming tasks in relation to their course studies.

4.11.4 Summary of end-of-session information from the main questionnaire

In section 4.11 I have presented the analysis of the information collected in the end-of-session part of the main questionnaire. The students were not familiar with using an associative network like PedNett, intended to provide ideas for pedagogic terminology to be used in organizing work tasks and for information searching. Several informants expected word definitions, apprehending PedNett as a dictionary or encyclopedia.

The main benefits of PedNett use, as perceived by the student informants, are that PedNett helps them elucidating how pedagogic concepts can be interpreted in several ways, and to relate different pedagogic terms in a new and meaningful way. The students also found that PedNett helps them in coming up with related terms, as well as narrower and broader terms in query formulation and reformulation.

4.12 RQ1: What characterizes students' elaboration of information-based work tasks and formulation of information needs in the prefocus stage?

In this and the following two sections I will co-ordinate the results from the analysis performed in this chapter, in light of my three research questions. The students' formulation behaviour have been characterized according to six variables; i.e. PedNett user type, learning style, previous studies in pedagogy, prior knowledge of the assigned work task, number of terms, and formulation behaviour in the prefocus stage. The first question concerns how students formulate their information needs in the prefocus stage. So this section concerns findings related to the first 5 terminological steps, in which the students activated their individual frames triggered by terminological activities (and without PedNett use). I specifically look at the structured brainstorm (step 3) and the formulation of tentative search terms (step 5).

We have seen that the students' brainstorm terms and tentative search terms (steps 3 and 5) are not less specialized/pedagogical than the teachers' word associations (cf. section 4.4.1), apart from some non-topical terms like *definisjon* 'definition', *betydning* 'meaning', etc. Step 5 terms are strongly related to the work task facet terms, and therefore some of the terms are used by a majority of the students conducting each work task.

When the students arrived at the informant session, they differed in several respects. I collected data on learning style, previous studies in pedagogy, and prior knowledge of the assigned work task. Examples of other variables which might also affect students' prefocus formulation behaviour are personality, IQ and grades in the topical area – however, they were not included in the data collection.

Three of the variables explored in the empirical data have an influence on the number of terms produced in the students' *structured brainstorm* (step 3). First, students with prior knowledge of the assigned work task – in the meaning that they had already made an outline – had a very high number of self-produced terms in their brainstorms. In making an outline, they had already activated their current knowledge on the work task topics prior to the informant session. The second most influential factor is the students' degree of deep learning style – in that a high score on deep learning style is related to a large brainstorm vocabulary (high deep → high number of self-produced terms in steps 3). Students with a strong deep learning style are characterized by an intention of acquiring a thorough understanding of the learning material, and they exhibit learning strategies like the 'use of evidence' and 'relating of ideas'. In using these strategies, they acquire richer frames in the topical area. Accordingly, they are able to recall a rich set of terms in the brainstorm activity. The third influencing factor on number of terms in step 3, is whether the students had conducted previous studies in pedagogy. This is related to a richer brainstorm vocabulary – but to a lesser degree than what we see with students with prior knowledge of the work task.

In step 5, there are two factors influencing whether the students select an above mean number of *tentative search terms*. Students who have already made an outline of the work task produce a high number of terms in step 5. This also applies to students with a high or middle degree of deep learning style. Previous studies in pedagogy do not seem to influence the selection of tentative search terms.

Vakkari (2000) observes that students produce a larger number of search terms in the later stages of a work task, than at the outset. He also claims that students' prior knowledge about a work task "considerably regulates how much and what kind of information is required and assessed as useful" Vakkari (2000:4). He finds that when students acquire topical knowledge, they produce more precise and larger numbers of search terms. This parallels term production in step 5 in the present study. Indeed, the 3 students who had made an outline of the work task before the informant session, exhibited a term production far above the mean value in step 5 (as well as step 3).

Six of the ten formulation behaviours laid out in section 4.5 are related to the first five terminological steps, i.e. facet-embracing, phrasing, facet-trusting, self-production, first-patching, and narrowing. *Narrowing* (i.e. the production of more specific term(s) in step 5 than what was provided in the work task facet terms) is related to a high degree of deep learning style. This shows an ability to select a focus and make an individual perspective on a work task. *Phrasing* (i.e. informants working at phrase or sentence level rather than at word level) is also related to a high deep score. This might be due to the thoroughness which characterizes the deep learning style. *Facet-embracing* (i.e. informants who select extra many terms in step 1, not only work task facets) is related to a low score on deep learning style. These are results on a group level - we have to remember, though, that on an individual level, informants exhibit a huge variation in formulation behaviour and combinations of characteristics used.

4.13 RQ2: How do students in the prefocus stage utilize teachers' frame knowledge expressed as word associations and relationship descriptions in the semantic network PedNett?

In this section I will assemble the results from my analysis in light of my *second* research question on how students can benefit from their teachers' terminological competence. How did PedNett help the students in their prefocus stage?

We have seen that PedNett was used for different purposes – *revision of structured brainstorm* (Enrichers), *reactivation of self-produced terms* from previous steps (Reactivators), and *recognition of search term candidates* (Applicators), or combinations of the latter two (Combiners). The Applicators primarily use PedNett to recognize relevant search terms in step 8. Combiners do the same, but they also reactivate their own terms from previous steps. Reactivators lend themselves on reactivating their self-produced terms, whereas Enrichers do not revise step 8, but rather use PedNett to revise the structured brainstorm in step 3. Only 3 out of 54 students make little or no use of PedNett: The Aloofer is reluctant in PedNett use, and the two Rejecters do not use PedNett for anything specific.

PedNett user types are defined with respect to the informants' number of terms in steps 6, 7, and 8, which again are influenced by the informants' learning style: On a group level, a *high score of deep learning style* caters for either an *above* or *below* mean *number of terms* in step 8 (cf. section 4.7.1). Taking PedNett user types into account, only the Applicators have an above mean number of terms in all the three steps 3, 5, and 8. Furthermore, the number of terms in step 5 relates to the number of terms in step 8, i.e. Applicators and Combiners have an above mean number of terms in steps 5 and 8, whereas Reactivators and Enrichers are below the mean number. When we consider the PedNett user groups across the high/middle/low deep score categories , there is a continuum of increasing degree of deep learning style in relation to PedNett user types, i.e. from Enricher (lowest), to Reactivator, Combiner, and Applicator (highest), cf. section 4.7.3. Most informants in the '*high degree of deep learning style*' category are *Applicators*, irrespective of number of terms.

When it comes to characteristics of formulation behaviour, *fastening* (i.e. adding no new PedNett-terms in step 8) and *first-patching* (i.e. using only one tentative search term in step 5) are related to the Enricher user type, whereas *removing* (i.e. removing one or several self-produced terms from previous steps) and *facet-embracing* (i.e. selecting extra many terms in step 1, not only work task facets) are related to the Combiner type. *Final-patching* (i.e. ending up with only one tentative search term in step 8) relates to Enrichers or Reactivators. However, we should keep in mind the *law of small numbers* (Kahneman 2011) concerning how extreme results are more likely in small data sets (section 3.4.4). So patterns which are related to the smaller PedNett categories, could be caused by coincidence.

When the students select PedNett terms, there is a huge variation in which terms they select. PedNett use contributes in a larger distribution of suggested search terms. A larger variation in search terms would probably lead to a variation in acquired information and students' individual perspectives in their assignments. The primary potential of PedNett is the activation of individual frames through recognition triggered by PedNett use. In the analysis I have tried to take into account that the students do not meet PedNett as 'tabula rasa': They have already activated their own frame knowledge in steps 1-5 (by *recall* on their own).

4.13.1 PedNett use: Activation of students' frame knowledge via recognition

The psychological feature of *recognition* over *recall* has been an important principle in the present project, and it motivated the elaboration of PedNett. The basic principle is that it is easier to *recognize* some information which is needed in a situation rather than to *recall* the same information from memory (cf. 2.5.2). PedNett does not primarily *add* terms to the students' vocabulary, but rather *activates* existing frame knowledge. The relationships between terms – and the unique descriptions of these relationships – indeed add to the students' frame knowledge, but the terms selected from PedNett are probably already contained in the students' own vocabulary. The students must be able to relate the PedNett cluster contents to their own frame knowledge. This claim is based on the finding that a high number of terms in step 5 is related to a high number of PedNett terms selected in step 8 (i.e. Applicators and Combiners). All this being said about PedNett as a *recognition tool* – that students can recognize something as relevant which they do not recall by themselves – this semantic network *can* also function as a *tuition tool*: By this I mean that students can acquire new knowledge on word meanings and relationships between words, via the effect of spreading activation (cf. 2.5.3 and 3.5).

Searching thesauri (also referred to as end-user thesauri) are used in query formulation and reformulation during search performance, and are defined as "a category of thesauri enhanced with a large number of entry terms that are synonyms, quasisynonyms, or term variants assisting end-users in finding alternative terms to add to their search queries" (Shiri & Revie 2006:463). As opposed to searching thesauri, PedNett is intended for use in the *prefocus* stage, as an idea generator in the process of revealing and formulating an information need. Whereas a searching thesaurus is typically a standard thesaurus (with hierarchical relationships) enriched with a lead-in vocabulary of associations, PedNett is solely based on unique associative relationships. During the terminological steps elaborated by the informants in the empirical study, the students recognized and selected terms from PedNett which they did not recall and come up with by themselves in the first place. One of the informants working on the Comprehensive school task, e.g., first suggested only terms coinciding with work task facets in step 5, e.g., *enhetsskole* 'comprehensive school'. After PedNett use, this student added three terms, e.g., *skolehistorie* 'school history'. Another informant, working on the Motivation task, first suggested *undervisning* and *motivasjon* as search terms in step 5. After using PedNett, the set of tentative search terms was enlarged by six terms, e.g., the related term *sosiokulturell teori* 'sociocultural theory' and the narrower term *indre motivasjon* 'intrinsic motivation'.

It is important to consider that for PedNett or any other recognition tool to be useful, there has to be some content stored in memory which the environmental context can be matched onto. When users find difficulties in coming up with efficient search terms to represent their information needs, the problem is not solved with a semantic tool like a searching thesaurus – or PedNett for that matter – if the user lacks knowledge and terminological competence in the topical area in question. There has to be some content stored in memory which can be activated by the external stimulus. Some 'memory hooks' already have to be there. For students there is a constant challenge in the interplay between getting the grip of the terminology used in the topical area they are studying, and the integration of this into their current frame knowledge. New terms need to be acquired, and new knowledge needs proper terminology to be organized. In learning new terms, one needs to enrich the body of frame knowledge attached to them.

Another condition for recognition tools to be useful, is that a given term not only has to be recognized as such, but the proper *context of use* has to be activated from memory. A student can respond to the raw familiarity of an item without being able to determine the context of use. The ability to activate the relevant context of use will improve with the acquisition and accumulation of frame knowledge. Students and teachers in a topical area differ not only in terms of the size of the vocabulary stored, but with respect to the body of frame knowledge associated with each word.

It is to be expected that topical area knowledge will improve the ability to formulate information needs and the benefit from semantic tools. Sihvonen & Vakkari (2004a, 2004b) studied topical area novices and experts in the field of pedagogy, performing *interactive query expansion* assisted by a thesaurus. Interactive query expansion research investigates how searchers reformulate their queries with some kind of tool, e.g., a thesaurus. Shiri & Revie (2006:463) state that the use of interactive query expansion "stresses the importance of decision-making as well as behavioural and cognitive characteristics of users in reformulating and expanding their search terms". Sihvonen & Vakkari (2004a, 2004b) found that in the reformulation of queries, novices selected from the thesaurus more broader terms and related terms than the experts, whereas the experts selected more synonyms and narrower terms than the novices. This represents a difference between a widening versus a narrowing of the scope of the searches. This result gives some expectations as to the findings in the present study on information need formulation assisted by PedNett – even, both studies are being performed in the topical area of pedagogy.

It should be mentioned, though, that Sihvonen & Vakkari (2004a, 2004b) define novices as students in other topical areas than pedagogy, and experts as undergraduate students in pedagogy. This means that Sihvonen & Vakkari's experts are parallel to the novices (i.e. the students) in the present study, as my informants were recruited among university college students of educational science taking a second year course of pedagogy (cf. section 3.2.3 on sampling strategy for the empirical study). So in the present study, all student informants using PedNett were experts according to Sihvonen & Vakkari's definition, and no comparison was made with students without any studies in pedagogy.

We saw in section 4.3.4 that rephrasing is considered by the students to be more difficult than the first term selection. This can be related to the winner-takes-all mechanism and the mechanism of output interference which was discussed in section 2.5 on psychological factors involved in the information need formulation process. It is well known that students find it difficult to find search term alternatives. Students often want to skip the stages of exploration and formulation and go directly from selecting the general topic for their work task to searching pertinent information for completing the assignment (Kuhlthau, Maniotes & Caspari 2007). In the present study, the students were triggered to dwell on the exploration and formulation stages through the prefocus terminological steps. PedNett was used by the students to activate and retrieve vocabulary in their individual conceptual frames, when revising their set of tentative search terms in the informant sessions.

There will always be a variation in acquired topical area knowledge between students attending the same course. Accordingly, I expected my empirical data to show a variation when it comes to the number of terms and the type of terms the informants selected from PedNett. I had no access to the students' grades in pedagogy, so I have not had the opportunity to analyse the variation in PedNett use caused by individual variations in topical area knowledge – however, since I recruited full classes, I expect a normal variation in terms of current knowledge.

4.13.2 The rationale for using teachers' word associations and relationship descriptions

In section 4.13 I have so far concentrated on the effects of PedNett use on the number of terms. In this sub-section I will look at other aspects of the transition from the students' first set of tentative search terms (step 5) to their revised set of terms after PedNett use (step 8). There is an increase in both *work task facets* and *terms representing each facet*. Most of the terms added are associative (i.e. related terms (RT)) which signifies that there is an increase in work task facets covered. In a traditional hierarchically structured thesaurus, the searcher is primarily provided with 'within-facet' terms (i.e. narrower terms (NT) and broader terms (BT)), rather than 'related-facets' terms (RT). This vouches for a combined application of both kinds of semantic tools, using an associative semantic network à la PedNett in the prefocus stage for exploratory searching – primarily widening the scope and adding facets/perspectives by related terms – followed by the use of a searching thesaurus in more focused searching, e.g., improving precision by using narrower terms.

From a cognitive linguistic perspective – claiming that linguistic structures are usage-based, and that entrenchment is related to frequency of use – all linguistic processing will trigger language users' frame knowledge and activate their vocabulary. So all kinds of language processing will be profitable in the prefocus stage, because then the user will have an active frame knowledge when s/he goes into the search stage and will thus be better prepared to handle and interpret the search results. My choice of using experts' frame knowledge (expressed as word associations and relationship descriptions) as a trigger, has been justified by the teachers' topical area expertise and their experience. Accordingly, their frames are richer, with a more entrenched vocabulary than the more scattered and meagre vocabulary of the students.

We saw that for word associations to be useful, they should be processed by experts with profound knowledge in the topical area (cf. section 3.3.2.1) – this will yield response words of high relevance and specificity. However, in comparing the students' vocabulary and the teachers' word associations (cf. section 4.4.1), I found that the students' vocabulary is *not* less specialized/pedagogical: 52 % of the students' vocabulary in step 5 in the Motivation task and 57 % of the teachers' word associations concurred with entries in the dictionary *Pedagogisk ordbok* (Bø & Helle 2008).

This was surprising for me at first, as I would have expected that a larger amount of the teachers' vocabulary would correspond to entries in the dictionary. However, in setting up PedNett, I did not edit or remove any of the teacher's word associations – as did, e.g., Lykke Nielsen (2002) when she used experts' word associations as input to enrich an existing thesaurus categorized into classical thesaurus relationships. In my study I used the associative data directly as input to the PedNett database. The teachers' vocabulary is – in conformity with the students' vocabulary – related to teaching practice and attitudes/values in teaching, and less theoretically oriented than the dictionary used for comparison. In this practically oriented part of pedagogic terminology, many of the words are found in everyday language – they are just assigned special meanings in a pedagogic context. So then, in what respect is the teachers' vocabulary preferable to that of the students? I think it is a matter of quality and quantity:

The potential change from step 5 to step 8 can be described both in quantitative and qualitative terms. Let us first look at the *quality* of the relationship descriptions. Because the teachers have expert knowledge and long experience in the topical area, they have richer frames and are thus better qualified in describing how different concepts relate to each other. Their frame knowledge is expressed both in the word associations and in the relationship descriptions. The change from step 5 to step 8 can be described in terms of potentially better search term candidates. I should add that this is rather an assumption than a conclusion, based on the fact that the teachers are experts in the topical area as compared to the students. The relationship descriptions contextualize the PedNett terms as specialized pedagogic terminology. This can contribute in the reformulation of tentative search terms, e.g., by getting from phrase level to word level, or getting from adjectives/verbs to nouns. I have however not compiled a sound set of quality criteria, apart from the characterization of the students' vocabulary as to whether their terms concur with the teachers' word associations in PedNett, as well as entries in the dictionary *Pedagogisk ordbok* (Bø & Helle 2008).

Now let us look at the *quantity* of the relationship descriptions: PedNett use causes a richer set of tentative search terms. The students recognize relevant search term candidates, primarily associatively related to the work task facets. All the Applicators and Combiners add terms from PedNett in their reformulation of tentative queries. I found that 67 % of the students' tentative search terms (apart from the work task facet terms) in step 5 of the Motivation task are found in PedNett (cf. 4.4.1). So the teachers are able to produce *more* pedagogic terms. (Note that when I compared the students' and the teachers' vocabularies with the dictionary in the previous paragraph, I considered how large *shares* of the students'/teachers' terms were found in the dictionary, and found them rather equal, respectively 52 % versus 57 %). The teachers produced a much *larger number of terms* in the word association test than the students produced in step 5. So the teachers' collective vocabulary as expressed in PedNett is much larger than any single student is able to produce by recall. The main potential benefit of PedNett thus comes from using it as a recognition tool in the prefocus stage – providing the same kind of terminology as the students are familiar with, but a richer amount, and with unique relationship descriptions between each pair of PedNett terms.

4.14 RQ3: How do differences in the students' use and evaluation of PedNett relate to differences in their learning style?

In this section I will assemble the results from my analysis from the perspective of my *third* research question on how students' learning styles affect their formulation behaviour. I have already dealt with several issues on this matter in the previous sections, so I will only summarize the findings briefly here: Informants with a high deep score on the ASSIST learning style test have a high frequency of self-produced terms in the structured brainstorm (step 3). In the tentative formulation of search terms (step 5), both middle and high deep score exhibit above mean number of terms. In the reformulation of tentative search terms (step 8), both high and low deep score exhibit above mean number of terms.

When students with a high degree of deep score apply many PedNett terms in step 8, they have already exhibited a large self-produced vocabulary in steps 3 and 5. In contrast, when students with a low deep score applies many PedNett terms in step 8, these are less corroborated to their current frame knowledge, because they exhibited a below mean number of self-produced terms in steps 3 and 5. When it comes to learning style in relation to PedNett user types, a majority of informants in the 'high degree of deep learning style' category turns out to be Applicators.

Formulation characteristics relates on a group level to the degree of learning style *above* (narrowing, removing, and phrasing), *around* (self-production, facet-trusting, and first-patching), and *below* (facet-embracing, fastening, adjusting, and final-patching) mean value. However, each informant with a given degree of deep learning style, may exhibit a combination of formulation behaviours across these three groupings.

We saw in section 3.4.1.2 that a *deep* approach to learning is characterized by an interest in a given topical area, focus on vocational relevance, and an intention of acquiring a thorough understanding of the learning material. Furthermore, the deep approach is associated with the learning strategies 'use of evidence' and 'relating of ideas'. The associative structure of PedNett supports the activation, strengthening, and integration of current knowledge with new knowledge and relationships between ideas. Based on the results of my study, we can now add to this list of characteristics of the deep learning style, by claiming that *a deep learning style is related to a high number of self-produced terms in work task elaboration and information need formulation*.

I have already mentioned the assumption that the variables I have studied are not just influenced by each other, but they are probably also influenced by other variables which are not included in the data collection, e.g., personality (cf. section 4.12). Peoples' behaviour patterns, cognition and emotions are influenced by their personality traits – most likely also their information behaviour, including searching.

Heinström (2002) explores student' searching styles and makes the categories *fast surfers*, *broad scanners*, and *deep divers*. She uses the ASSIST learning style test and a personality test (the NEO five-factor inventory[37]). Heinström finds that searching style is influenced by personality traits, students' attitudes towards their study, the topical area or discipline (humanistic/social/natural), the type of work task, and which work task stage they are in. She finds that personality does not *define* searching behaviour, but rather *influence* how the searching behaviour evolves. The influence of personality on information searching is explored further in Heinström (2010). Over time, users develop their own *information attitudes*, i.e. their particular ways to collect information. These attitudes are described on a continuum from a broad, invitational stance to a closed avoiding one. Heinström (2010:160, abstract of table) makes the following connections between information attitudes, personalities and search approach:

[37] Primary source, not consulted by me: Costa, P.T.Jr. & McCrae, R.R. (1997). Stability and change in personality assessment: The revised NEO personality inventory in the year 2000. In *Journal of personality assessment, 68*(1), 86-94. Cf. also http://www4.parinc.com/Search.aspx?q=neo%20five-factor.

Information attitude	Invitational	Exploring	Purposeful	Passive	Avoiding
Personality	Open	Open	Conscientious	Laid back	Sensitive
Search approach	Intuitive	Broad scanning	Deep diving	Fast surfing	Do not search

Table 4.14 Connection between information attitudes, personalities and search approach

The layout in the table above informs us that personality indeed has an impact on students' information behaviour and the way they search. Another study pointing at a relationship between searching style and personality traits, is Lönnqvist (2003), who explores researchers' searching styles. She finds no relationship between searching styles and which topical area the researchers are working with. She concludes with an assumption that searching style might be related to personality. (This is however not explored further by Lönnqvist, as she did not subject her informants to personality testing).

We have seen that learning style – together with other factors – have an impact on students' formulation of information needs and searching behaviour. What are the consequences of these findings? How can a recognition tool like PedNett be accommodated to differences in students' learning styles – or more specifically, to individual variation in deep learning style? Should this be done? There is no ranking order between learning styles, or a truism that 'the more search terms, the better'. Furthermore, students' learning styles are not constant, and may change during several years of study due to, e.g., personal experience and improved study skills (cf. section 3.4.1.2). Still, students who manage to express a large body of current knowledge in the different stages of their work tasks, certainly have an advantage when they are faced with an abundance of information.

Heinström (2010:166) directs the responsibility for compensating for unproductive learning styles to the *user*, rather than to the system or an intermediary: "[S]uccess is achieved by capitalizing on one's strengths and correcting or compensating for one's weaknesses".[38] The informants have to be information literate in several ways, including knowing their own learning style and how their learning style affects their information behaviour. I will pick up the discussion of learning styles with respect to information literacy in section 5.4.

[38] Heinström cites Sternberg (2003). Primary source, not consulted by me: Sternberg (2003). Giftedness according to the theory of successful intelligence. In N. Colangelo and G. Davis (Eds.), *Handbook of gifted education* (pp. 88-99). Boston, MA: Allyn & Bacon.

4.15 Reflections on the results in light of shortcomings in the research design

In this section I will consider how the shortcomings of the Prearrangement study and the Revealment study have had an impact on the empirical results. In the research design of the *Prearrangement study*, I considered three shortcomings affecting the reliability and potential practical use of PedNett; first, the number of teacher informants, second, the number of processings of each stimulus word, and third, the inconsistency of the relationship descriptions (cf. section 3.3.6). I noted then that the number of teacher informants affected the number of processings of each stimulus word, with the consequence that I could not make *frequency* effects an issue. This could have been resolved by more teacher informants performing word associations, or a selection of fewer stimuli words, or a combination of the two. I considered also the general feature of word associations, that they are produced out of context of real multi-faceted work tasks.

We have seen in the empirical study that the informants had difficulties in understanding the *general nature of the relationship descriptions*. This applied both to the teachers in producing the relationship descriptions, and to the students in interpreting them. I was very concerned that the relationship descriptions should not contain definitions of single words (i.e. each of the response words produced to a stimulus word), but that they should contain an explication of the *relationship between* the stimulus and response word.

In retrospect, I think that it might have been a better solution to instruct the teacher informants to indeed provide *definitions* of each response word, from the perspective of the stimulus word. The contextualization of the definition with respect to the stimulus word, would be secured via the associative links. The functionality with right and left arrows indicating the direction of the associative relationship, is already included in PedNett.[39] Another solution might be to use the relationship descriptions as raw material for the elaboration of a definition of each PedNett entry term. This would introduce a third element in the network, in addition to the word associations and the relationship descriptions. In entering a PedNett cluster, the user might be provided with a definition of the entry term as well as each associated term by pointing at them – and the *expand* function would still provide relationship descriptions.

[39] E.g., in the PedNett cluster for *læring* ‘learning’, a right arrow ‘→’ in front of the first relationship description for *lek* ‘play’ indicates a relationship description between the entry term *læring* as stimulus word and the expanded term *lek* as response word, whereas left arrows ‘←’ in front of the following relationship descriptions indicate the opposite, i.e. *lek* as stimulus word with *læring* as response word.

In the research design of the *Revealment study*, I made some reflections on the methodological choices of using simulated work tasks and the ASSIST learning style test (cf. section 3.4.4). The disadvantage of the work tasks not being settled before the collection of associative data in the Prearrangement study, gave a low PedNett coverage (especially for one of the work tasks, cf. 4.4.2). Ideally, all the work task facet terms should have been processed as stimuli words – and several times each.

Concerning the exploration of the first research question on how students formulate their information needs in the prefocus stage (cf. terminological steps 1-5), I had no control group in which the informants would just be presented with the work task and then would be asked to provide tentative search terms (i.e. performing only step 5). The consequence of this is that I cannot compare tentative search term formulations *with* versus *without* activation of vocabulary in steps 1-4.

In steps 6-8 all the informants used PedNett. I did not test other forms of terminological elaboration of information needs, with the consequence that I cannot compare PedNett use as trigger versus other trigger activities, e.g., the use of a searching thesaurus, a reference interview with an intermediary, or a collective brainstorming with co-students. However, I do not consider these consequences as drawbacks in the research design, as they were consciously made. I have had no wish to *prove* whether PedNett is better than other linguistic trigger activities. I did not *measure* the effect of PedNett use in the prefocus stage. I have used PedNett for two purposes – primarily to be able to collect empirical data on how students formulate their information needs in the prefocus stage, and second, to observe how they utilized a specific kind of trigger, i.e. a semantic network containing teachers' associative data.

My handling of the empirical data, the categorization PedNett user types, and the interpretation of emerging patterns are all results influenced by my theoretical approach, assumptions and experiences. The results are indeed related to the body of data collected for this specific project. In analysing my complex empirical data, I have sometimes found myself struck by the *elsewhere syndrome.* When I find a pattern between two variables in the data, I might at the same time have the feeling that "it is all happening somewhere else" (Lacey 1976:71). This is "a common ailment in fieldwork, where the researcher feels it necessary to try to be everywhere at once" (Hammersley & Atkinson 2007:159). This might result in collection of a great deal of data at the expense of reflection on the significance of the data. Information need formulation involves far more factors than I have had the opportunity to include in the present study, so even if there seems to be a relationship between two factors, the explanation can still lie somewhere else – instead, or in addition – to what I manage to see.

4.16 Case-study research with a qualitative approach: Reflections on the results in light of my research design guidelines

In the analysis in chapter 4 I have several times commented on the huge individual variation between the informants. In section 3.1.1 I stated that my aims for the research design and analysis are compatible with case-study research. Inspired by Flyvbjerg (2007), I established the following five guidelines for my research design and analysis: 1) collect concrete, contextual knowledge to be used in a case-study, 2) make a careful selection of cases which will be subjected to in-depth analysis, with a basis in my research questions, 3) include critical cases but be cautious in seeking causes and consequences for them, 4) consider the aim of the inquiry to be understanding and learning of phenomena (rather than proving of hypotheses), and – last but not least – 5) include complexities and contradictions, just as in real life. In accordance with these aims, I have provided several in-depth descriptions of individual cases in this chapter. How has this contributed in the analysis – what kind of insights can these descriptions bring which differ from findings which can be made using a quantitative approach? First and foremost, I have demonstrated the complexities in the empirical data. A quantitative analysis would have blurred the fact that the individual variation is very prominent. Still, to be able to pin-point tendencies in the data, I have organized the informants into PedNett user types – keeping in mind that there is no completely ‘pure’ example of each category. Establishing the PedNett user types is useful in a demonstration of the potential application areas for PedNett – in the revision of brainstorm vocabulary, as well as the selection of search term candidates.

In the analysis I have used a frame semantic approach to the understanding of the student informants’ performance, considering information need formulation as a process of enriching cognitive frames. With this point of departure, the large individual variation of the brainstorm terminologies is expected – since frames are individual and the words activated by a work task will depend on each individual’s frame content. I have claimed that the Applicator and Combiner types demonstrate that PedNett use can encourage the users’ formulation abilities when individual conceptual frames are activated through the mechanism of recognition. The differences in the students’ and the teachers’ vocabularies are explained by claiming that the teachers’ frames are richer and easier accessible for them, because of their experience and expertise in the topical area. When students have to fend for themselves in the search situation, they can easily get overwhelmed by information overload. When students activate their current frame knowledge by terminological elaboration and PedNett use in the prefocus stage, they will be better prepared to handle the wealth of information which they are faced with once they go online, searching for information.

4.17 Summary of chapter 4 Presentation and analysis of empirical data

In this chapter I have explored the empirical data collected from the students who participated in the Revealment study, which was conducted with 54 student informants. The major part of the analysis has concerned the 8 terminological steps performed by the students, elaborating on an assigned work task, first *without* and then *with* semantic input from PedNett. For ease of reference, the terminological steps were referred to as selection (step 1), brainstorming (2), structuring (3), clarification (4), formulation (5), structure revision (6), clarification revision (7), and formulation revision (8). These labels were established as a part of the research design in section 3.4.2.2. The analysis was structured around *variables*, *examples*, and *patterns* found in the empirical data. The variables were: PedNett user types (4.2), learning style (4.3.1), previous studies in pedagogy (4.3.2), prior knowledge of the assigned work task (4.3.3), number of terms (4.4.2), and formulation behaviour in the prefocus stage (4.5). My goal has been to provide a thorough presentation of the actual data, as well as collocations and interpretations.

Chapter 4 has been laid out according to the following structure: In section 4.2 I presented a categorization of six *PedNett user types*, provided with the nick names Applicator, Combiner, Reactivator, Enricher, Aloofer, and Rejecter. Section 4.3 contained a presentation of *information collected before the 8 terminological steps*, including the ASSIST learning style test. In section 4.4 I characterized *the students' vocabulary* before and after PedNett use, both in terms of kinds and numbers of terms.

The informants exhibited other examples of variations apart from instantiating different kinds of PedNett user types. To be able to describe this, I elaborated a classification of ten characteristics of *formulation behaviour* in the prefocus stage. These characteristics were provided with the labels facet-embracing, phrasing, facet-trusting, self-production, first-patching, narrowing, fastening, final-patching, removing, and adjusting – and they were presented in section 4.5. Section 4.6 contained an *exemplification* of the PedNett user types (which were defined in 4.2) and characteristics of formulation behaviour (according to the classification in 4.5), represented by one informant from each user type.

Sections 4.7-4.10 were used to present the *patterns* I have found in the empirical data, in three bulks; first, patterns related to the variables learning style, number of terms, and PedNett user types (4.7) – second, previous studies in pedagogy and prior knowledge of the assigned work task (4.8) – and third, the relationships between learning style, formulation behaviour, and PedNett user type (4.9). In section 4.10 I presented an overall model (figure 4.2) illustrating the patterns between the six variables. This model was referred to throughout the analysis in the preceding sections. Section 4.11 provided an analysis of the information collected in the *end-of-session* part of the main questionnaire, concerning perceived work task and search task challenges, as well as the students' opinions on potential benefits of PedNett use.

In sections 4.12-4.14 I used the results of the analysis in answering my *three research questions*: RQ1: What characterizes students' elaboration of information-based work tasks and formulation of information needs in the prefocus stage?, RQ2: How do students in the prefocus stage utilize teachers' frame knowledge expressed as word associations and relationship descriptions in the semantic network PedNett?, and RQ3: How do differences in the students' use and evaluation of PedNett relate to differences in their learning style?

In the analysis I arrived at the following answer to my *first question* (cf. 4.12) concerning how students formulate their information needs in the prefocus stage *before* PedNett use: On a group level, there is a quantitative difference between the students when it comes to richness of terms produced in the structured brainstorm, and for the set of tentative search terms. This is related to three factors, i.e. prior knowledge of the work task, degree of deep learning style, and previous studies in pedagogy. The most influential variable was whether the students had already made an *outline* of the work task – which is related to a number of terms far above the mean number both in the brainstorm and in the production of tentative search terms. The second most influential variable was the students' *degree of deep learning style* – in that a high degree of deep learning style is related to a large brainstorm vocabulary, and a high or middle degree of deep learning style is related to an above mean number of tentative search terms. A third matter, but with less impact, was whether the students had conducted *previous studies in pedagogy*. This was related to a higher number of terms in the structured brainstorm, but did not influence the production of tentative search terms. I also found qualitative differences in terms of variations in formulation behaviour – notably that *narrowing* (i.e. the production of more specific search term candidates than what was provided in the work task facet terms) is related to a *high degree of deep* learning style, whereas *facet-embracing* (i.e. informants who select extra many work task facet terms) is related to a *low degree of deep* learning style.

The *second research question* (cf. 4.13) was related to how students can benefit from their teachers' terminological competence by using PedNett in the prefocus stage of their work tasks. I found that most of the students used PedNett for revision of the brainstorm vocabulary. Students with a high degree of deep learning style also used PedNett in the revision of search term candidates – either as a trigger in the reactivation of their own vocabulary, or as input for new tentative search terms.

When it comes to the *third research question* (cf. 4.14) on how students' learning styles affect their formulation behaviour, I found that when students with a *high degree of deep learning style* apply many PedNett terms in the reformulation of tentative search terms, they have already exhibited a large self-produced vocabulary on their own. They are also able to perform *removing* of terms, which shows an ability to single out irrelevant aspects in the process of focusing a work task.

In the analysis I found that the students' vocabulary is not less specialized/pedagogical than the teachers' word associations. The difference between the students' and the teachers' vocabulary is primarily quantitative rather than qualitative. The main potential benefit of PedNett comes from using it as a recognition tool in the prefocus stage – providing the same kind of terminology as the students are familiar with, but a richer amount, and with unique relationship descriptions between each pair of PedNett terms. PedNett triggers both the *activation* and *enrichment* of students' frame knowledge.

In this study I have explored how students elaborate their work tasks and formulate their information needs in the prefocus stage. The students were not asked to perform actual searches, as I wanted to focus on the cognitive aspects of the production and selection of search term candidates *prior* to search onset. Accordingly, I have no empirical data on how the revised set of tentative search terms in step 8 might contribute in search effectiveness. Further research would be required to explore this aspect.

In the last two sections of the analysis in this chapter I have provided some reflections on the results in light of shortcomings in the research design (cf. 4.15). I also discussed the results in light of the guidelines I had laid out for my empirical study, using case-study research with a qualitative approach (4.16). The next chapter will be dedicated to a discussion of the implications of my findings in light of current research on the Google generation and information literacy literature.

Chapter

5

Discussion of results

5.1 Introduction: Information-based work tasks and digital actors

In this chapter I will discuss the empirical results in relation to my research questions. The arguments will be framed in relation to current research on the impact of 'the Google generation era' on contemporary learning and teaching. This is to set the scene into which I have to relate my findings. I will use three different perspectives, referred to as the *digital native* perspective, the *critical* perspective, and the *information literacy* perspective. I will refer to the users/students as digital *actors* rather than *consumers*. This is in line with the discussion in section 1.3.1, in which I mentioned the relevance of Prahalad & Ramaswamy's (2004) concept of *co-creation* with respect to information searching. Users of digital information are not passive information *consumers*, but information *actors*, participants in a co-creation process of digital information.

Current research on 'the Google generation' displays a myriad of interpretations of the present-day situation. The selection of the three perspectives listed above has been done because I want to be able to point out some main lines and important distinctions between the different 'voices'. They represent two opposing viewpoints of students' competencies in a digital context (cf. 'digital natives' versus the critical 'incompetent digital actors' view), as well as an intermediary, more pragmatic approach (cf. the information literacy perspective). The first perspective of today's digital information scene which I will deal with, represents 'the digital actors knows best'-point of view, whereas the critical perspective asks '*does* the actor really know best'. The information literacy perspective maintains a pragmatic attitude in asking 'what does the digital actor *need* to be information literate'.

When I collected the empirical data in 2009, all the student informants reported that they used the Internet, most of them daily or weekly. In the same year, Gunter, Rowlands, & Nicholas (2009) reported that computers had taken up the position as the preferred source of information, and replaced other forms of communication (such as print, radio, television, and telephone). Since then, the technological development has changed the information behaviour of young people even further, in that mobile devices take precedence over laptops/desktop computers – this is called 'the second digital transition' by Nicholas & Clark (2013). However, we should remember that research on the Google generation typically concerns information *seeking* behaviour – i.e. any methods students employ to gain access to information. Current information seeking research is concerned with the emergence of new forms of knowledge production, search and acquisition – in a very wide context.

There is, e.g., a huge difference between looking for information on when the next bus leaves for the city centre, and searching for information for a student assignment – which is the kind of information searching I have been concerned with in this thesis. Approaching social media with information-related questions (as many online users do) is also very different from searching for pertinent information in article databases as a part of a work task process. The idea of *users as digital consumers* (Rowlands & Nicholas 2008) is a frequent topic in current information seeking research – or, as I would put it, users as digital *actors* (cf. section 1.3.1). This research primarily concerns *digital media habits and use* – not specifically *information searching* in the interpretation used in the context of this thesis, as the human-computer interaction with an information system in association with an information-based work task.

Much media use is for entertainment or leisure purposes, not information acquisition induced by work-task-related information needs. Mobile searches are typically shorter, less interactive, and with less content viewed per visit, as compared to searches performed from desktop devices (Nicholas & Clark 2013). When the same authors state that mobile users are the fastest-growing user community on the Web – and that mobile devices will soon be the main platform for searching – this fact includes all kinds of information searching, not just the kind performed by students working on assignments. Still, since Internet has become the preferred source of information and it can all be accessed from mobile devices, students' general information seeking behaviour is of course relevant also in relation to information-based work tasks. In adapting system design and information literacy training, we have to know students' information habits.

The rest of this chapter is arranged according to the following structure: I will start, in section 5.2, by recapitulating what was the starting point of this empirical project, and pin-pointing the main outcome of the analysis. Sections 5.3-5.5 will comprise the announced discussion of the three different perspectives on modern students' challenges and needs as learners in a digital context – from the *digital native* perspective, the *critical* perspective, and the *information literacy* perspective. In section 5.6 I will consider the consequences of my empirical results in light of these perspectives, with respect to system design, information professionals, and the students themselves – before I provide a summary of the discussion in section 5.7.

5.2 Cognitive user revealment: Point of departure and main outcome of the analysis

Let us first recapitulate what was the starting point of this empirical project. My overall concern has been how students elaborate their information needs in the prefocus exploration stage of information-based work tasks. I have labelled this process *cognitive user revealment* (cf. section 1.2.1), understood as the cognitive process and resulting state of students in their elaboration and formulating of information needs throughout the search process.

The prefocus stage is a difficult and often frustrating stage for students. They face the challenging task of expressing their knowledge gap ('what they do not know') when they elaborate their information needs. Students are easily overwhelmed in the prefocus exploration stage, before they have arrived at a topical focus. The way students terminologically handle the prefocus stage has an impact on the end result of the information search process. More research is needed in this field. This empirical project has been motivated by a wish to shed some light on the prefocus stage of students' information need formulation, as a contribution in the knowledge formation process on this research topic. I have explored whether students can benefit from teachers' terminological competence provided as semantic input from the associative network PedNett, and whether students' learning styles affect their formulation behaviour.

In relation to the research questions, the findings can be summarized as: The variation in students' formulation of information needs is related to prior knowledge of the work task, degree of deep learning style, and previous studies in pedagogy. Most students benefit from their teachers' terminological competence by using an associative semantic tool in the prefocus stage of their work tasks for enriching their own brainstorm. Students with a high degree of deep learning style also used the semantic tool in the revision of search term candidates – either as a trigger in the reactivation of their own vocabulary, or as an input for new tentative search terms. When students with a high degree of deep learning style select many terms from the semantic tool in the reformulation of tentative search terms, they have already exhibited a large self-produced vocabulary on their own.

A recurring theme in the analysis has been the topic of students' *degree of deep learning style*. The patterns in the data show that a *high* degree of deep learning style is related to a large brainstorm vocabulary, a rich self-production of tentative search terms, as well as an active use of PedNett in the revision of search term candidates. Students with a high degree of deep learning style also exhibit the ability of narrowing (i.e. the production of more specific search term candidates), as well as removing (singling out irrelevant aspects in the process of focusing a work task). The characteristics related to a high degree of deep learning style are all favourable when it comes to formulation of information needs. The ability to activate one's current knowledge with a rich vocabulary – as well as being able to adjust the expression of the information need as it develops in the prefocus stage – is certainly advantageous. So the analysis indicates that those students who benefit most from PedNett use, are the students who also manage well on their own – i.e., students with a high degree of deep learning style. When these students select many terms from PedNett in the reformulation of tentative search terms, they have already exhibited a large self-produced vocabulary on their own, both in the brainstorm, and in search term suggestions. Fortunately, students can influence on their learning styles by selecting productive learning strategies – as I will argue in the following discussion.

We have seen that students' learning styles characterize the various ways in which they elaborate, acquire and remember new information, i.e. individual differences in their approach to learning with respect to intentions, motives, and learning strategies (Diseth & Martinsen 2003). A deep approach to learning is characterized by a thoroughness which is reflected in an intention of acquiring a careful understanding of the learning material. Students with a deep approach are motivated by interest, and tend to study beyond the course requirements. Furthermore, the deep approach is associated with learning strategies like the relating of new ideas to prior knowledge and to everyday experience in a vigorous interaction with the content (Diseth 2001).

In section 3.4.1.2 I claimed that no learning style is considered better than another learning style per se, but that the idea is to adapt teaching strategies corresponding to the students' different learning styles – or for students to be aware of their own learning style as a part of their study technique. The results of my empirical study indicate that students with a high score on the deep learning style have an advantage with respect to richness, availability, and flexibility of vocabulary. One might say ‘what a pity, then, that we are not all born with a deep learning style’. However, a student’s learning style is not written in stone, and it may change during several years of study – when students acquire more experience, improve their study skills, and learn to compensate for non-productive approaches in their studies (Diseth 2001; Heinström 2010). Although students tend toward different learning styles at the outset of their studies, good teaching and good study techniques can influence students in the direction of a deep approach to learning. If students are better off with a deep learning style, this should preferably have consequences for the planning of their own learning strategies, for topical teaching, as well as information literacy training – and even for system design. I will return to the question of students’ learning styles in the following discussion, especially in section 5.4. First, however, we will have a look at the *digital native* perspective on the Google generation.

5.3 The *digital native* perspective: The Google generation - Hungry for highly digested content

In this section I will present characteristics which are often ascribed to the Google generation, a label referring to young people growing up in an Internet-dominated, media-rich culture. The Google generation’s information seeking behaviour “can be characterised as being horizontal, bouncing, checking and viewing in nature” – these actors are “hungry for highly digested content”, and spend much time skimming and multitasking (Rowlands et al. 2008:294). The *digital native* perspective refers to an assumption ascribed to this generation that “young people are whizzes at technology, and searching information is almost as natural as breathing to them” (Nicholas et al. 2011).

> The untested assumption is that this generation is somehow qualitatively “different” from what went before: that they have different aptitudes, attitudes, expectations and even different communication and information “literacies” and that these will somehow transfer to their use of libraries and information services as they enter higher education and research careers. (Rowlands et al. 2008:291)

The Google generation has been the topic of much research, e.g., the British Library project “The behaviour of the researcher of the future” (reported, e.g., in Gunter, Rowlands & Nicholas 2009; Nicholas et al. 2011; Nicholas & Clark 2013; Rowlands et al. 2008; Rowlands & Nicholas 2008). Young people in the Google generation are quick information searchers;

they spend little time dwelling, and undertake only a few searches in answering a question. They are rushing their moves, relying on point-and-click and copy-paste.

Mills, Knezek & Khaddage (2014) explore the use of mobile learning technologies and students' preferences, placing the learner in control of the learning experience. They state that students have preferences for self-expression and sharing in their knowledge acquisition process. They claim that mobile access and social media facilitate the connection between formal and informal learning (in class/outside class activities). Beheshti & Large (2013) provide several perspectives on social networking as part of students' information behaviour. This is all in line with the 'mobile and online 24/7' notion of young people.

Research on the Google generation is not only concerned with the information behaviour of young people, but also the role of the information specialists, as well as the libraries. In the introductory section of this chapter I called the *digital native* perspective '*the actor/consumer knows best*'-point of view, inspired by Nicholas (2008:214-215, my emphasis), who claims that "the information community must stop thinking it knows best, otherwise it will be in danger of becoming irrelevant. *The consumer knows best*".

Nicholas (2012:29) throws a firebrand in pin-pointing his personal opinions on what the information profession must learn from digital actors, when he states that "[t]he digital transition took out the information middlemen – librarians – a process called disintermediation", and that this situation in his opinion is ignored by librarians – "this is very much the elephant in the room". Nicholas says that users today manage very well on their own in communicating and sharing information in horizontal networks without intermediaries. He claims that "[t]oo many libraries and librarians exist in a parallel universe to that inhabited by their users. Librarians must understand how differently people seek and use information in cyberspace and realign information services along new lines" (Nicholas 2012:30).

Nicholas has been met with much critique from the information science research field, by representatives who demonstrate that library services and librarians certainly have reshaped the profession in a digital environment. Audunson (2012) is convinced that Nicholas is fundamentally wrong when he believes the technology eliminates the need for the librarian as an intermediary and communicator. Young people are not born into the world fully equipped with information literacy and searching skills (as, indeed, even Nicholas' own research show). Having good skills with regard to using ICT for entertainment purposes, does not automatically make students information literate. Many students lack the information competence which is a prerequisite for higher education. This point of view – that young people are *not* born as digital natives – is a major concern for Kirschner & van Merriënboer (2013), whose article the next sub-section (on the *critical* perspective) is based on.

5.4 The *critical* perspective: Urban legends concerning students, learning, and teaching

Whereas the previous section presented 'the students as digital actors know best'-point of view, the *critical* perspective asks: 'Do learners really know best'? Kirschner & van Merriënboer (2013) discuss three 'commonly believed truths' about learners, learning, and teaching. They call these *urban legends*, understood as claims that are generally held to be true, but is based on belief rather than science. The article takes a critical look at three pervasive urban legends in education, concerning students as *digital natives,* having *specific learning styles*, and seen as *self-educators*. These legends are all variations of one central theme, namely that 'it is the learner who knows best and that she or he should be the controlling force in her or his learning'. The authors claim that these urban legends are not based on educational and psychological research, and they make it their mission to eradicate them. They base their arguments on empirical research – including their own – according to an *instructional design* approach, which aims at making knowledge acquisition more efficient and effective for students. Because Kirschner & van Merriënboer's claims might be considered as rather controversial for information science researchers, I will in the following layout include references (in footnotes) to some of the sources which they refer to.[40]

The first contemporary belief about students which Kirschner & van Merriënboer want to refute, concerns the supposition that learners know best how to deal with new technologies for learning – i.e., the *learner as a digital native* legend. This legend embraces the notion that students are highly information-competent (cf. the digital native perspective described in the previous section). *Homo zappiens* is considered to learn in a different manner than previous generations. Kirschner & van Merriënboer (2013) refers to research[41] which claims that children in this generation all by themselves develop the metacognitive skills necessary for

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[40] Kirschner & van Merriënboer refer to a line of development of *instructional design theory*: Gagné, R., & Briggs, L. (1979). *Principles of instructional design* (2nd ed.). New York, NY: Holt, Rinehart, and Winston. / Merrill, M. D. (1994). *Instructional design theory*. Englewood Cliffs, NJ: Educational Technology Publications. / van Merriënboer, J. J. G. (1997). *Training complex cognitive skills: A four-component instructional design model for technical training*. Englewood Cliffs, NJ: Educational Technology Publications. / van Merriënboer, J. J. G., & Kirschner, P. A. (2013). *Ten steps to complex learning* (2nd Rev. ed.). New York, NY: Taylor & Francis.

[41] Primary source, not consulted by me: Veen, W. & Vrakking, B. (2006). *Homo Zappiens: Growing up in a digital age*. London: Network Continuum Education.

inquiry-based learning – without any instruction. Digital natives are considered to be highly efficacious multitaskers. Proponents of multitasking refer to this way of working as utilizing ‘the benefits of distraction’. High exposure to digital media is supposed to rewire people’s brains, promoting multitasking and complex reasoning. Kirschner & van Merriënboer (2013:171) refute these ‘common truths’ with reference to the *butterfly defect* seen in “a generation where learners at the computer behave as butterflies fluttering across the information on the screen”, without a conscious plan for their next moves. Referring to cognitive neuroscience as well as cognitive science studies on human-computer interaction[42], Kirschner & van Merriënboer claim that multitasking actually involves dividing one’s attention between several tasks. Because each task competes for a limited amount of cognitive resources, the performance of one interferes with that of another (cf. the interference effect discussed in section 2.5.4.2). According to their arguments, multitasking and task switching impair performance and learning – and they conclude that in their opinion, homo zappiens and the multitaskers do not exist.

The second urban legend concerns *students’ learning styles*, considered from two angles – both that students are aware of their own learning styles, and that successful learning requires the teachers to diagnose the learning style of each student, and adapt their teaching in accordance with the students’ styles. Kirschner & van Merriënboer (2013) make arguments that the notion of learning styles does not provide any useful point of departure for teaching methods, particularly because there is no simple two-way interaction between learning styles and instructional methods. They also find it problematic that the determination of students’ learning styles is done by self-reported measures instead of objective measures of cognitive abilities. They make the case that the *preferred* way of learning for a student does not need to be the most *productive* way of learning – much the same as the situation with food intake – people’s preferences with respect to food can be completely unrelated to what is healthy for them. Rather than adapting teaching to each student’s individual preferences, students should be taught to compensate for counterproductive aspects of their learning styles:

> From an educational point of view, it is probably more fruitful to focus on the fundamental things that learners have in common [...] than the myriad of styles on which they may be different from each other. A focus on what learners have in common does not deny that there are individual differences; rather, it helps to identify differences that really matter in education and to design instructional methods that are practically feasible. For example, there is scientific evidence that objectively measured cognitive abilities

[42] They refer to, e.g.: Dux, P.E., Ivanoff, J., Asplund, C.L., & Marois, R. (2006). Isolation of a central bottleneck of information processing with time-resolved fMRI. In *Neuron, 52*, 1109–1120. doi:10.1016/j.neuron.2006.11.009, and: Brumby, D.P., & Salvucci, D.D. (2006). Exploring human multitasking strategies from a cognitive constraint approach. In *Proceedings of the 28th Annual Conference of the Cognitive Science Society*, 2451. Mahwah, NJ: Erlbaum.

> and, especially, prior knowledge, should be taken into account when instructional methods are applied. Kirschner & van Merriënboer (2013:175)

The third urban legend concerns the belief that *students are self-educators* on the Internet, because all one needs to know and learn is 'out there on the Web'. Kirschner & van Merriënboer (2013:176) claim that we have seen a 'Googlification' of education, based on an idea that "we should not teach knowledge but should instead let kids look for it themselves". Students are thought of as being competent in information problem solving because they are frequent Internet users. However, the use and availability of electronic devices does not make students digital natives. "[S]tudents must learn to solve information-based problems and must learn transferable search and evaluation strategies" (Kirschner & van Merriënboer 2013:177). The authors emphasize that to be able to handle today's information growth; one must be able to search, find, select, evaluate, process, organize, and present information with skilled training. In short, the students need *information literacy* competence. This is often referred to as *digital literacy* when it concerns information literacy in a digital context – understood as the ability to use information effectively, in all formats, in a largely digital information environment.

Kirschner's own research suggest that prior knowledge on a topic determines the behaviour and success of students in an information search process[43] – and conversely, low prior knowledge negatively influences the search process.[44] Prior knowledge on a topical area should be revealed as a part of course studies, because students with low prior knowledge learn best from studying *examples*, whereas students with higher prior knowledge learn more from *solving* the equivalent problems. "Students with more prior knowledge have an advantage because they can easily link their prior knowledge to the task requirements and to information found on the web" (Kirschner & van Merriënboer 2013:177). The authors describe the typical situation of students who receive assignments requiring them to handle an information need and construct new knowledge. In this situation a minimal prior knowledge is a hindrance for the students' success in problem solving.

Findings from the present study correspond to Kirschner & van Merriënboer's claim that prior knowledge is an important factor in learning. Students with prior knowledge on the

[43] Primary sources, not consulted by me: Kirschner, P.A. (1992). Epistemology, practical work, and academic skills in science education. In *Science and Education, 1*, 273–299. doi:10.1007/BF00430277, and Kirschner, P.A. (2009). Epistemology or pedagogy, that is the question. In S. Tobias & T.M. Duffy (Eds.), *Constructivist instruction: Success or failure?* (pp. 144–157). New York, NY: Routledge.

[44] Primary source, not consulted by me: Fidel, R., Davies, R.K., Douglass, M.H. et al. (1999). A visit to the information mall: Web searching behavior of high school students. In *Journal of the American Society of Information Science, 50*(1), 24–37. doi:10.1002/(SICI)1097-4571.

work task or previous studies in the topical area, have a richer vocabulary in their information need elaboration. The results of the empirical study also indicate that the use of PedNett-kind of tools can facilitate the students' activation of current/prior knowledge – which is very promising in this respect.

Kirschner & van Merriënboer (2013) conclude that students in general are not autodidacts when it comes to navigating through and learning in the digital world – they need digital literacy instruction. This coincides with the point of departure in the following section on the *information literacy* perspective, which will be continued by a discussion of consequences of my empirical study, cf. section 5.6.

5.5 The *information literacy* perspective: Students' challenges and needs as information actors in a digital context

In the two previous sections we have looked at 'the user knows best perspective' as well as the 'does the learner really know best' critical questioning. The *information literacy* perspective takes a pragmatic approach in asking 'what does the user *need*' – and the answer is information literacy training. There is a rich literature offering solutions as to how students can improve their information literacy skills. Devine & Egger-Sider (2014) and Secker & Coonan (2013) offer strategies and teaching tools for information literacy training. These are practical frameworks written by information professionals who are in charge of digital literacy programmes. Mandalios (2013), based on an empirical study, offers a practical tool for helping students evaluate Internet sources, called the RADAR approach, an acronym referring to the need for the students to establish the Relevance, Authority, Date, Appearance and Reason for writing of each Web source that they encounter. The application of critical pedagogy in library instruction is advocated in Accardi, Drabinski & Kumbier (2010) and Smith (2013), emphasizing the importance of information literacy training to encourage critical thinking as a democratic goal.

Students need to learn strategies for accessing *the Invisible Web* (Devine & Egger-Sider 2014). The body of information on the Web is like an iceberg, with only the tip of the iceberg visible above the surface – the rest is invisible. Devine & Egger-Sider present two definitions of the concept of the Invisible Web, i.e. the traditional technology-based definition, and the cognitive definition. The *traditional* definition says that the Invisible Web is the part of the World Wide Web which is omitted from the results presented by general-purpose search engines because it is not included in its indexing – e.g., because it is overlooked by the indexing 'spiders', or because the information is fee-based or requires a password. The *cognitive* definition of the Invisible Web says that all the information which is *overlooked* by users in searching the Web, is included in the cognitive Invisible Web. "At its most basic, cognitive invisibility occurs because people's research skills are limited by what they know and what they do not know" Devine & Egger-Sider (2014:12). Many students have never heard of – let alone learnt about – Invisible Web resources; accordingly they do not make the Invisible Web a part of their research tool kit.

Teachers and librarians need to communicate the importance of using a rich set of search strategies, rather than simply relying on one or two techniques that only skim the Web's surface. This still holds true, even though general-purpose search engines improve all the time in capturing information resources which used to be a part of the Invisible Web. Web searching is now shifting to a more social and human-intermediated service – but with peers, not information professionals, in the intermediary position:

> The information world has just made a complete circle, from a fully human-centered search process conducted in libraries and focusing on printed books and journals, to an automated function perfected by Google with its PageRank system finding vast amounts of electronic information on the Internet, and now to a social-centered research method where students rely heavily on peers within their social networks and on somewhat narrowly focused mobile apps. (Devine & Egger-Sider 2014:52).

This is the context in which I have to discuss my empirical results. In the next section I am going to look at the consequences of my findings in light of the *digital native*, the *critical,* and the *information literacy* perspectives presented above.

5.6 Considering the empirical results in a digital context of knowledge formation

In the examination of students as digital actors in sections 5.3-5.5, I have organized the discussion around three perspectives, to contrast the arguments. Irrespective of the fundamental point of departure, most researchers acknowledge that the Google generation indeed face a challenge in handling their information needs – also researchers associated with the *digital native* perspective. "There is little evidence in the literature generated for claims that young people are expert searchers, or even that the search prowess of young people has improved with time" (Gunter, Rowlands, & Nicholas 2009:129). As before the Internet, students still have difficulties formulating appropriate search terms or finding alternative terms if their original search proved unsuccessful. Digital literacy "is a vital 'life skill' for anyone in today's world. All those aiming to work as an information specialist must have a high level of digital literacy themselves, and will be expected to help others achieve the same" (Bawden & Robinson 2012: 287).

We have seen that the digital information context for students today is complex, growing, and in constant change. I adhere to a pragmatic view, that information literacy training should be an important element at all educational levels. In asking 'what do the users need in a digital environment' in the following sub-sections, I will discuss the consequences of my empirical study in relation to design of retrieval systems, work routines of information professionals, and teaching of students.

5.6.1 System design: Scenario for recognition tools à la PedNett

The semantic network PedNett was developed to be used in the experimental setting of this study, with a dual purpose – for the data collection of students' information behaviour, and as a tool for triggering the activation of students' vocabulary. In section 3.3.6 I considered the shortcomings in the research design of the Prearrangement study. I then stated that I would return to a discussion of recommended improvements, if one were to make a semantic tool à la PedNett for a real-life purpose. This is the topic of the present sub-section.

Based on the empirical results, the structure of such a semantic network in a specific topical area should be based on unique *associative relationships*, provided by expert contributors in the form of *word associations*. In line with my considerations in section 4.15, I would suggest that the experts – in addition to the word associations – should elaborate *definitions* of the response words. We have noted that students are in a situation in which they have to acquire terminological competence and conceptual knowledge in a topical area which is new to them. In providing definitions of the entry terms in an associative network, the students' conceptual process of enriching their frame knowledge will be enhanced.

For a PedNett-kind of tool to be useful, the stimuli words would have to be processed a lot of times – preferably at least 50 times each (cf. 3.3.2.4 where I referred to Deese (1965) who states that the frequency of distribution of response words stabilize around the level of 50 respondents). This strategy would facilitate an arrangement according to decreasing *frequency*. A cut-off value would have to be established, e.g., displaying only stimulus-response word pairs produced by at least 3 informants. Words pairs processed only once or twice would 'explode' the network (as it did in PedNett) and thus provide the students with a too scattered semantic input. Even though frequency is related to entrenchment on an *individual* level – in language users' unique frame knowledge – I think that an arrangement according to frequency would also be useful in the presentation of *shared* terminology within a topical area, as clusters in an associative network.

I envisage a *wiki*-like terminological tool which could be compiled on a voluntary basis by experts in a topical area. A wiki is a Web application which allows people to add, modify, or delete content in collaboration with others.[45] The terminological tools initiated by the Language Council of Norway demonstrate examples of such a compilation principle.[46] Examples of three entries in their term-wiki for digital terminology are provided in appendix 26. Each entry in the term-wiki from the Language Council provides a definition, a specification of area of use, the English equivalent, and sometimes also synonyms, and/or a further comment. These wikis do not, however, include associative relationships between the entry terms, which I think should be an important part of this kind of tool. (Some entries do, however, have links from terms occurring in definitions – to the same terms occurring as entry terms. This applies to, e.g., the terms *nettside* 'web page', and *nettsted* 'web site' in the definition of *hjemmeside* 'home page' in the second example listed in appendix 26). A collaborative elaboration of an associative network would require an editorial function, e.g., when it comes to the selection of stimuli words, and maintenance of the network.

An important issue for a semantic recognition tool along these lines, would be the availability and how it should be presented. If a tool is to be provided in the manner and the place where students spend most of their time online, it should be provided in the form of a mobile app, i.e. an application for smartphones and other mobile devices. The application area for a semantic tool of this kind would be as an idea generator in the prefocus stage of information-based work tasks – 'bridging the gap' between the students' own vocabulary and the terminology used in documents. This could be used with general search engines, or vis-à-vis library databases or other sources on the Invisible Web. Such an application could also be used as a tool for teachers and students in classroom activities, curriculum reading, or other course requirements.

5.6.2 Information literacy and learning strategies: Consequences for information professionals and students

When Kirschner & van Merriënboer (2013) conclude that students are not the best managers of their own learning in the digital world (cf. section 5.4), I think that a reasonable aim for

[45] Cf. http://en.wikipedia.org/wiki/Wiki.
[46] Cf. http://www.termwiki.sprakradet.no./wiki/Hovedside.

information professionals should be to *enable* students to manage on their own. I think that successful learning requires that students take charge of their own learning – not in the interpretation ‘don’t worry, it is all out there on the Internet’, but in acknowledging which skills are required to handle all the sub-tasks of the information search process, and make an effort to acquire these skills.

Knowledge about students’ information behaviour is a prerequisite for information professionals to support students in their learning, specifically in information literacy training. I think that the findings of my study add a share to our understanding of students’ formulation behaviour in the prefocus stage of information-based tasks. The terminological steps used in the Revealment study can be used as a model for students’ elaboration of information needs in the prefocus stage; i.e. clarification of assignment topic/keywords (step 1), brainstorming (2), organization of the brainstorm terms in relation to main topics/keywords (3), clarification of information need (4), and search planning with respect to sources and terms (5). The categorization of PedNett user types (cf. section 4.2) demonstrates the application areas of such a semantic recognition tool – as a trigger for the activation vocabulary, and as an idea generator in the structuring of work tasks and expression of information needs. The classification of formulation characteristics elaborated in the empirical study (cf. 4.5) illustrates the complexity and individual variation in students’ formulation behaviour.

The question of learning styles has been a recurring matter in this project. The analysis indicated that a high degree of deep learning style is favourable for students’ abilities in activating their current knowledge and formulating information needs. Kirschner & van Merriënboer (2013) question the mere existence of learning styles – and they claim that, in any case, learning styles do not offer a useful approach for adaptation of teaching and learning strategies. They maintain that instructional intervention should rather focus on design principles for learning materials, as well as students’ prior knowledge and cognitive abilities reported in an objective manner. I am not in a position to resolve this question.

I cannot make any general claim on an eventual relationship between learning styles and students’ information behaviour, apart from the patterns I have pointed out in the empirical data. However, I think that there is a useful point to be made in acknowledging the difference between learning *styles* and learning *strategies.* We have seen that learning styles (if indeed they exist) characterize various ways in which students elaborate, acquire and remember new information – like an innate, unconscious quality of students. Furthermore, we have noted that each learning style is related to specific learning *strategies*. Some students choose a thorough approach in their studies, all by themselves. However, those who don’t, can learn how to plan their studies in a more fruitful manner. So students can be taught to become aware of the strategies they have used unconsciously – and learn more successful strategies. In this respect I conceive of learning strategies as 'potentially conscious'.

We might question – do students choose a given learning strategy because they have a specific learning style – or is it the other way around, that students who select certain strategies exhibit certain learning styles? I think the point of the matter is that students certainly can influence their own learning strategies – irrespective of their individual differences, qualifications, skills, and starting points. Students naturally change in the course of their studies, in many respects, as a consequence of their efforts and the experiences they gain – and they can choose the direction of this change.

The fact that students and develop and improve their own learning styles in the course of their studies, gives a new perspective on the empirical results. The favourable relation between a high degree of deep learning style and the ability to activate one's own vocabulary and relate new ideas to current knowledge, is something every student can aim at – not something you are born to or not. Everyone can improve their learning strategies in a beneficiary direction if they work for it – with different conditions for success, certainly, but still. Rather than tailoring teaching to specific learning styles, students should be instructed – by teachers and information professionals – on how they can adapt their learning strategies and compensate for non-productive approaches in their studies. This should not be done by "brute force", but adapted to the students' individual differences, e.g., with respect to cognitive skills and developmental abilities.

But are we not then back where we started – tailoring instruction to each student? From my point of view, education of children should – ideally – indeed be adapted to each individual. However, maybe not to their learning styles. Rather, the adaptation should be related to prior knowledge (adjusting the level), personality, cognitive skills, and developmental abilities. These matters were briefly discussed in section 4.14, mentioning Heinström's (2010) research on the influence of personality on information searching.

A major concern in education should be 'learning how to learn' – including information literacy, acquisition of productive study techniques, and how to make the most out of one's strengths. When learners become students in higher education, they should preferably be able to take charge over their own learning, including information literacy skills and learning strategies. However, the rapid change of the digital environment necessitates a constant renewal of these skills. So the information professionals will still play a central role at all levels of education.

In this project I have been concerned with how students can reveal and express their information needs understood as 'knowledge gaps' in relation to information-based work tasks. I think that students also need to reveal their 'information literacy knowledge gaps'. Many students are satisfied with the search engines they already use and the information they find – the visible Web admittedly answers many questions quite well. So why should information professionals teach them strategies for using the Invisible Web? I think the answer to that is growing in front of us: The exponential growth of information and the far-from-perfect information architecture on the Web – makes it more and more obvious that the challenge is not to 'find information', but to reduce the complexity and the amounts of information. Information *quality* and *reliability* of sources protrude as motivational factors for mastering the Invisible Web. *Availability* of information is not the same as *ability* in information handling.

5.7 Summary of chapter 5 Discussion of results

In this chapter I have discussed the results of my analysis in light of the digital learning context of the Google generation. I started out with recapitulating the starting point of this empirical study (cf. section 5.2). I found that a recurring theme in the analysis was that students with a *high* degree of deep learning style are better able to activate their current knowledge and formulate their information needs. In sections 5.3-5.5 I contemplated students' situation as digital actors from three angles, i.e. 'the digital actor knows best'-point of view, contrasted with an opposing critical view, followed by a pragmatic view advocating information literacy training. Using these perspectives as a sounding board for my further discussion, I considered the consequences of my empirical results with respect to system design, information professionals, and the students themselves (cf. section 5.6).

I suggested a wiki-like terminological tool which should be available as a mobile app, to be used as an idea generator in the prefocus stage of information searching, as well as in teaching activities. Information professionals should enable students to take charge over their own learning, by instructing students on how they can adapt their learning strategies and make the most out of their strengths. Students will have to master the Invisible Web if they want to ensure quality and reliability in the selection of information sources. They need to reveal and remedy their 'information literacy knowledge gaps' in a digital context in constant change.

5.7.1 Main findings in relation to the research questions

We have seen that activation of current knowledge is central in all learning. In the discussion of empirical results, I have arrived at the following conclusions:

Conclusions related to RQ1 concerning students' formulation of information needs in the prefocus stage of their information-based work tasks:

- According to patterns found in the empirical data, the variation in students' formulation of information needs is related to:
  - prior knowledge of the work task
  - a high degree of deep learning style
  - previous studies in pedagogy
- These three variables contribute to a rich number of terms in the students' brainstorm and formulation of tentative search terms.
- Students' formulation of information needs are possibly also influenced by other variables which have not been included in the empirical study, e.g., personality, IQ, and grades in the topical area.

Conclusions related to RQ2 concerning whether and how students might benefit from their teachers' terminological competence, provided as the associative network PedNett:

- PedNett was used for various purposes, specifically the *revision* of the students' structured brainstorm, *reactivation* of self-produced terms from previous terminological steps, and *recognition* of search term candidates.
- The primary potential of PedNett is to be used as a *recognition tool*, for the activation of individual frames. In using PedNett, the students are able to recognize something as relevant which they do not come up with by themselves.
- PedNett also has a potential as a *tuition tool*. During PedNett use, the students can acquire new knowledge on word meanings and relationships between words.

Conclusions related to RQ3 concerning the influence of individual learning styles on students' formulation behaviour:

- Two groups of students select an above mean number of PedNett terms in the reformulation of tentative search terms, respectively the students with a *high,* or a *low* degree of deep learning style.
- When students with a *high* degree of deep learning style select a rich set of terms from PedNett in the reformulation of their own tentative search terms, they have already exhibited a large self-produced vocabulary on their own. Their selection of PedNett terms is related to their current knowledge, activated in the brainstorming of their tasks.

5.7.2 Implications for system design

Students would benefit from using a terminological tool for the topical area they are exploring. The semantic network should be compiled from topical area experts' word associations and word definitions. This terminological tool could be complied as a wiki on a voluntary basis, and should be provided as an application on mobile devices. The structure of the tool should be based on unique associative relationships between words, as well as definitions of each word, from the perspective of each of is associated words. The arrangement of related words for each entry term should be according to decreasing frequency. Figure 5.1 below provides an illustration of a network based on words related by unique associative relationships, and with definitions of each work pair. Each word is defined with respect to each of the other words it is related to.

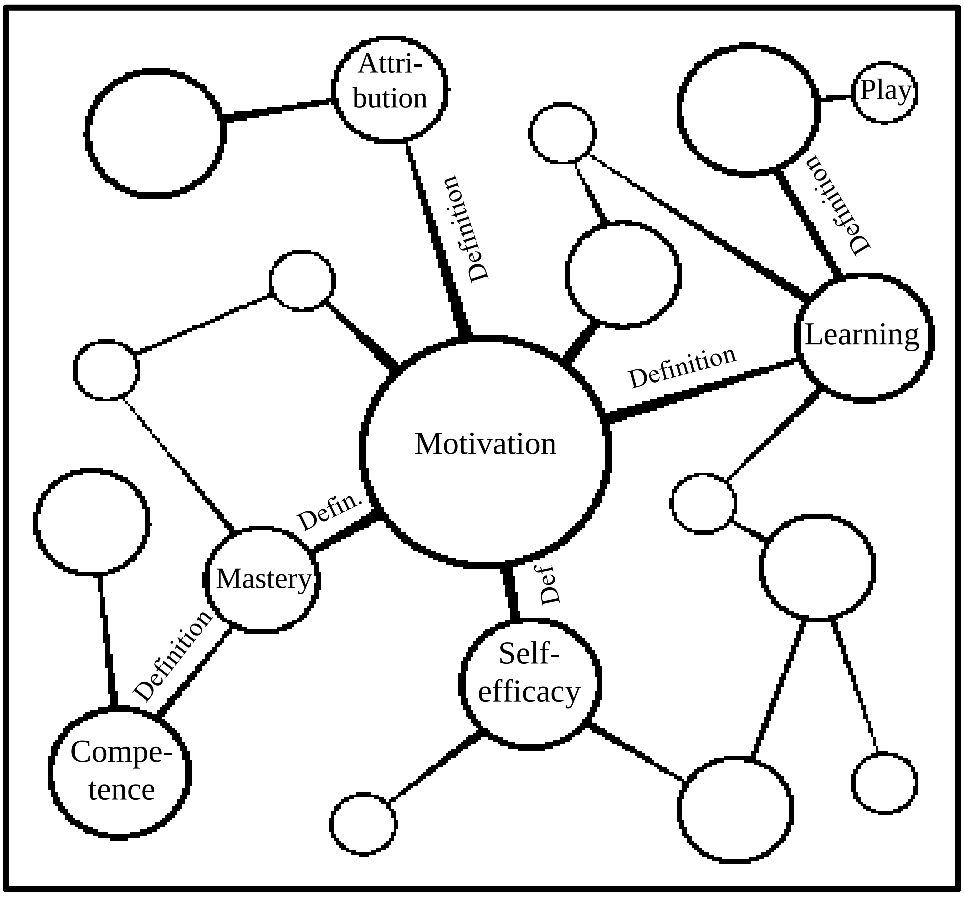

Figure 5.1 Network based on unique associative relationships

5.7.3 Suggestions concerning information literacy and learning strategies

- Information professionals need to communicate the importance for students of using a rich set of search strategies, rather than simply relying on one or two techniques that only skim the Web’s surface.
- Students should be instructed in an awareness of their own learning styles, and be advised to adapt their learning strategies – making the most out of their strengths, and compensating for non-productive approaches in their studies.

The need for quality information in education necessitates the need for literacy training.

Chapter

6

Summary and conclusion

6.1 Summary of objectives and results

The aim of this thesis has been to explore how students reveal their information needs in the prefocus exploration stage of information-based work tasks. Elaborating information needs is a process of knowledge formation in which students have to activate their vocabulary and relate new ideas to their own current knowledge. This involves the handling of information which is not yet integrated as meaningful knowledge, due to the 'knowledge gap' actualized by the task requirements. Previous research has investigated several perspectives of this challenging task (Bates 1977; Cole 2012; Nordlie 2000), of which I have been concerned with the cognitive aspects – thus the application of the concept *cognitive user revealment*. Students face a semantic barrier of expressing 'what they do not know' when they have to organize their work tasks and select terms to represent their information needs.

Students elaborating on their information needs have difficulties formulating appropriate search terms or finding alternative search terms if their original terms prove unsuccessful, a problem which has not disappeared with new technology (Devine & Egger-Sider 2014; Gunter, Rowlands, & Nicholas 2009). The present study was aimed at uncovering several aspects of these terminological challenges, particularly in the early stage of students' work tasks. Furthermore, the empirical study contains a suggestion for how students can gain access to their teachers' experience and expert knowledge in a topical area, by way of a semantic tool. This has been implemented and tested in a pilot version, as an associative semantic network in the topical area of pedagogy.

The motivation for investigating students' cognitive revealment in the prefocus stage has been twofold. First, findings concerning students' challenges and needs in information need formulation can be used in the development of built-in tools in searching systems. These can be used as terminological idea generators for students in an early stage of their work tasks. Second, knowledge about this process have implications for information professionals and students, in that it provides a framework for information literacy training – which is a matter both of *enabling* students to manage on their own in a digital environment, as well as a responsibility imposed on the students to take charge of their own learning.

I have specifically explored whether, and how, students can benefit from semantic input from a tool based on expert's terminological understanding. For this purpose I have compiled an associative network called PedNett. In the introductory chapter of this thesis, I formulated the following research questions: RQ1: What characterizes students' elaboration of information-based work tasks and formulation of information needs in the prefocus stage?, RQ2: How do students in the prefocus stage utilize teachers' frame knowledge expressed as word associations and relationship descriptions in the semantic network PedNett?, and RQ3: How do differences in the students' use and evaluation of PedNett relate to differences in their learning style? The motivation for including a learning style test in this study, was because the idea of individualized learning styles has been much used in education and psychology (Diseth & Martinsen 2003), as well as in information science (Heinström 2002) – based on the idea of adapting teaching methods to fit with each student's learning style.

I have applied an interdisciplinary approach to my research topic, using information searching theory, cognitive linguistic theory, and cognitive psychological theory. The motivation for this choice is that I have investigated the information need formulation process from a cognitive point of view. Cognitive linguistic theory understands the linguistic capacity as an integrated part of our general cognitive abilities. The frame semantic approach within this linguistic approach is fully compatible with cognitive psychology, and has provided me with a theoretical basis for the understanding of the knowledge formation process. In acquiring new terminology in a topical area, students have to relate new ideas to their current understanding – i.e. they have to enrich their frame knowledge, understood as conceptual knowledge related to word meanings.

The interdisciplinary theoretical framework was presented in chapter 2, starting with a presentation of three models of the information search process. These models, as well as Cole's (2012) information need theory, provided me with a basis for understanding the information need formulation process, and design how to investigate this process – the prefocus stage in particular. I have described the representation, modelling, and activation of conceptual knowledge of this process from a cognitive linguistic perspective. Furthermore, I have discussed some psychological factors involved in information need formulation. The presentation of the theoretical framework applied in this thesis was concluded by making an integration of perspectives on meaning, information, and knowledge, drawn from information searching, cognitive linguistics, and cognitive psychology.

Chapter 3 was devoted to the research design of the empirical study, including theory of method applied in the data collection. The two parts of the study was labelled the *Prearrangement study*, and the *Revealment study*, of which the first one was a prerequisite for the latter one. I wanted to explore students' elaboration of their work tasks because this activity involves the assignment of information needs, the revealment process of these information needs in several stages, as well as information searching. The knowledge-formation process of students' information-based work tasks provided me with a relevant setting for the investigation of information need formulation. The data collection was performed in the topical area of *pedagogic terminology,* with students and teachers from the field of educational science as informants. The semantic network PedNett was compiled as a part of the Prearrangement study, based on teachers' associative data. The PedNett database was used in the Revealment study, in which I investigated students' prefocus information need formulation behaviour in a laboratory setting. The students were assigned a simulated work task and elaborated their task in 8 terminological steps, arriving at tentative search term formulations. This was done twice, first without any tools, and afterwards with input from PedNett.

The most extensive part of this thesis is made up of chapter 4, containing the analysis of the empirical data collected in the Revealment study. The analysis was structured around six variables (i.e. PedNett user types, learning style, previous studies in pedagogy, prior knowledge of the assigned work task, number of terms, and formulation behaviour in the prefocus stage), and resulted in a presentation of findings concerning each of the three research questions. I have used a primarily qualitative approach, demonstrating the complexities in the data and individual variation between the informants in providing in-depth presentations of examples of each PedNett user type. These examples demonstrate potential application areas for PedNett – as a semantic tool in the organization of work tasks in the prefocus stage, and as an idea generator for tentative search terms. I have pointed out patterns found in the empirical data, particularly the impact of three of the variables (i.e. learning style, prior knowledge of the work task, and previous studies in the topical area) on the richness of terms used in the formulation of information needs. A recurring theme in the analysis has been the role of students' *degree of deep learning style*, which appears to be favourable in the information need formulation process. This is because it is related to richness of terms and an ability to revise and enlarge the set of search term candidates.

In the discussion of the empirical results in chapter 5, I framed my arguments in relation to the digital learning context of the Google generation. The outcome of this study is relevant only if it can be connected to the digital learning context and information behaviour of modern students. I have presented the consequences of my empirical study in relation to design of retrieval systems, work routines of information professionals, as well as teaching of students. I looked at students as digital actors from several perspectives, as the picture of the current situations for students is multi-faceted. The interpretations of students' challenges and needs vary from a 'digital native'-perspective to a critical view as to whether students are competent as information actors in a digital learning context. In the discussion I adhered to a pragmatic view, asking 'what do the users need in a digital environment', emphasizing the need for adequate semantic searching tools, as well as information literacy training.

6.2 Revisiting cognitive user revealment: Students' information need formulation in the prefocus stage

Students' cognitive revealment in the prefocus stage of information-based work tasks is characterized by large individual variations. Deep learning style, prior knowledge of the work task, and previous studies in the topical area relates to the richness of terms used by the students in the organization of their work tasks and the expression of their information needs. PedNett appears to be a useful tool for the activation and enrichment of students' vocabulary in the prefocus stage, as an idea generator, and a trigger of current knowledge. Students who exhibit a rich vocabulary in their own structured brainstorms and tentative search term formulations, appear to benefit more than other students from PedNett use. These students use PedNett both in the reactivation of their own terms from previous terminological steps, as well as the recognition of relevant search term candidates which they did not come up with by themselves. They have a high degree of deep learning style – a learning style which is related to an ability to relate new ideas to prior knowledge in the learning process. Their learning strategies are characterized by a thoroughness in the way they approach their work task process. These students also exhibit an ability to produce more specific search term candidates than what was provided in the work task facet terms.

In the course of this thesis we have seen how user revealment involves a gradual transition from uncertainty to certainty (Kuhlthau 2004), from complexity to the reduction of complexity (Wersig 2003), and from fear to flow (Heinström 2010). Information becomes meaningful for students – and contributes in their knowledge formation process – when they are able to integrate new knowledge with their current knowledge.

6.3 Recommendations for future work

In discussing the application areas of associative semantic networks à la PedNett, I suggest a wiki-like tool available as a mobile application. This comes as a consequence of framing my analysis in relation to the information behaviour of the Google generation. When it comes to consequences for information professionals and the students themselves, I emphasized the need for information literacy training – as well as learning strategy instruction – to enable students to take charge of their own learning in a digital context in constant change. With a constant growing body of information provided at the Internet, students are in danger of aimless searching in a 'sea of hits' if they are not able to use quality and reliability criteria in the selection of information. Students need to be able to reveal not only their knowledge gaps in the context of work tasks, but what they do not know in relation to their own digital literacy.

6.4 Conclusion: Activated current knowledge enhances students' abilities in information need formulation

This thesis adds to our knowledge about the cognitive process of students' formulation of information needs in the prefocus stage of information-based work tasks. The outcome of the analysis can be emphasized in a few statements: The point of departure for all learning should be the students' current knowledge (Imsen 2005), because students learn by building on what they already know (Kuhlthau, Maniotes & Caspari 2007). Current knowledge can be activated by terminological elaborations of various kinds (Evans 2006; Jackendoff 2002). I have particularly investigated how students' current knowledge in the prefocus stage can be activated by the use of a semantic tool, compiled from teachers' word associations and definitions.

Based on my analysis, I will claim that students indeed can benefit from experienced teachers' understanding of a topical area, by using a tool containing a network of associative data produced by their teachers. The semantic input in such an associative tool will enhance the students' conceptual process of enriching their frame knowledge. This tool can be used as a trigger for the activation and enrichment of students' current knowledge, enabling them to express their information needs in the information search process. The empirical results indicate that this is especially true for students with a deep learning style, who exhibit an ability to formulate their work tasks with a rich vocabulary, also on their own. Students should accordingly be encouraged to apply learning strategies associated with a deep learning style if they want to improve their digital literacy.

For a semantic tool to be useful in the prefocus stage, students have to acquire learning strategies characterized by a thoroughness in the way they approach the work task process. This includes terminological elaboration of their information needs prior to search system interaction. Therefore, students should be advised as to how they can adapt their learning strategies in a productive manner with respect to information literacy and learning outcome.

The structure of a semantic tool of the kind piloted in this study should be based on unique associative relationships between words. Each entry should be defined from the perspective of each of its associatively related words, and the arrangement of related words should be according to decreasing frequency. The suggested tool could be complied as a terminological wiki on a voluntary basis. A semantic tool of this kind should be available on the digital platforms students apply, and be used in bridging the gap between the students' own vocabulary and the terminology used in information available on the Web.

My main conclusion from this study is that activated current knowledge enhances students' abilities in information need formulation. This can be stimulated by the use of associative semantic tools, as well as by an increased digital literacy among students.

Appendices

Appendix 1 Ethics protocol approval

Norsk samfunnsvitenskapelig datatjeneste AS
NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Harald Hårfagres gate 29
N-5007 Bergen
Norway
Tel: +47-55 58 21 17
Fax: +47-55 58 96 50
nsd@nsd.uib.no
www.nsd.uib.no
Org.nr. 985 321 884

Grete Seland
Avdeling for journalistikk, bibliotek- og informasjonsfag/P48
Høgskolen i Oslo
Postboks 4 St. Olavs plass
0130 OSLO

Vår dato: 07.05.2009	Vår ref: 21553 / 2 / IB	Deres dato:	Deres ref:

KVITTERING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 23.03.2009. All nødvendig informasjon om prosjektet forelå i sin helhet 04.05.2009. Meldingen gjelder prosjektet:

21553	*At the semantic Barrier: Supporting Information need Formalization employing user-derived Descriptors and inter term Relationships*
Behandlingsansvarlig	*Høgskolen i Oslo, ved institusjonens øverste leder*
Daglig ansvarlig	*Grete Seland*

Personvernombudet har vurdert prosjektet og finner at behandlingen av personopplysninger er meldepliktig i henhold til personopplysningsloven § 31. Behandlingen tilfredsstiller kravene i personopplysningsloven.

Personvernombudets vurdering forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, eventuelle kommentarer samt personopplysningsloven/-helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/forsk_stud/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://www.nsd.uib.no/personvern/prosjektoversikt.jsp.

Personvernombudet vil ved prosjektets avslutning, 31.12.2011, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

for
Bjørn Henrichsen
Mette Alsheim

Inga Brautaset
Inga Brautaset

Kontaktperson: Inga Brautaset tlf: 55 58 26 35
Vedlegg: Prosjektvurdering

Avdelingskontorer / District Offices:
OSLO: NSD. Universitetet i Oslo, Postboks 1055 Blindern, 0316 Oslo. Tel: +47-22 85 52 11. nsd@uio.no
TRONDHEIM: NSD. Norges teknisk-naturvitenskapelige universitet, 7491 Trondheim. Tel: +47-73 59 19 07. [illegible]
TROMSØ: NSD. SVF, Universitetet i Tromsø, 9037 Tromsø. Tel: +47-77 64 43 36. [illegible]

Appendix 2 Consent form of Prearrangement study

Deltakelse i Grete Selands PhD-prosjekt, HiO/Bibin[47]

Samtykkeerklæring for informant

Jeg har blitt informert om hva dagens undersøkelse går ut på. Mitt bidrag som informant omfatter ordassosiasjoner og benevning av relasjoner mellom termer, samt et etterfølgende intervju. Jeg samtykker i at de innsamlede dataene kan brukes i Grete Selands PhD-prosjekt i anonymisert form.

Sted/dato: ______________________________

Underskrift: _____________________________

[47] HiO/Bibin refers to the Norwegian acronym of my institutional affiliation at the time of the data collection, i.e. Høgskolen i Oslo, Bibliotek- og informasjonsstudiene. The English name today is Oslo and Akershus University College of Applied Sciences, Department of Archivistics, Library and Information Science.

Appendix 3 Translation of consent form of Prearrangement study

Participation in Grete Seland's PhD project, HiO/Bibin

Consent form for informant

I have been informed about the topic of today's informant session. My contribution as informant includes word associations and descriptions of relationships between words, as well as a subsequent interview. I approve that the collected data, in an anonymous version, can be used in the PhD project of Grete Seland.

Place/date: ______________________________

Signature: ______________________________

Appendix 4 Example of word associations and relationship descriptions

Two teacher informants' responses to the stimulus word *læring* 'learning'. Grey areas in the texts below indicate where I have made corrections in the edited versions (cf. appendix 5).

Læring	
Lek	Lek og læring har sammenheng med hverandre i barnehagen. dette har med at barna uttrykksform ofte er lek er lekpreget aktivitet i småbarnalder. Det er derfor kunstig å sette lek og læring opp som motsetninger til hverandre. Mange prosjekter barna kan arbeide med gjøres ved hjelp av lekpreget og kreativ aktivitet der barn får uttrykke seg og komme med egne ideer og assosiasjoner. reproduksjon av kunnskap som den voksne sitter inne med bør ikke ha stort omfang i barnehage.
Sosialisering	det å vokse inn i en institusjon eller samfunn er ofte det vi forstår med sosialisering. Dette skjer enten man ønsker det eller ei. Men det erforskjell på tilpassende sosialisering eller dannende sosialisering . Den sistnevnte har sterk relasjon til læring slik jeg ser det.
Utvikling	*Teorier om barns utvikling har blitt kraftig kritisert derfor er det vanskelig for meg å bruke ordet. Det innebærer for meg ikke en statisk eller stadiemessig utvikling. Eller endimensjonal. utvikling kan gå i ulike retninger – som en rhizome – slik Deleuze sier. Men noe skjer – en endring skjer. Dette ligger i utviklingsbegrepet for meg. [removed italics]*

Læring	
fag	læring skjer inenfor et fag_
kunnskap	resultat av læring_
erfaring__	fører ogte til læring_
opplevelse__	fører ofte til læring- nødvendig for læring_
utforsking	elevens vei mor læring_
aktivitet__	en forutsetning for læring_

Appendix 5 Edited version of word associations and relationship descriptions

Two teacher informants' responses to the stimulus word *læring* 'learning'. Edited versions - as entered into PedNett - of the original texts which were provided in appendix 4.

Læring	
Lek	Lek og læring har sammenheng med hverandre i barnehagen. Dette har med at barnas uttrykksform ofte er lekpreget aktivitet i småbarnalder. Det er derfor kunstig å sette lek og læring opp som motsetninger til hverandre. Mange prosjekter barna kan arbeide med gjøres ved hjelp av lekpreget og kreativ aktivitet der barn får uttrykke seg og komme med egne ideer og assosiasjoner. Reproduksjon av kunnskap som den voksne sitter inne med bør ikke ha stort omfang i barnehage.
Sosialisering	Det å vokse inn i en institusjon eller samfunn er ofte det vi forstår med sosialisering. Dette skjer enten man ønsker det eller ei. Men det er forskjell på tilpassende sosialisering eller dannende sosialisering. Den sistnevnte har sterk relasjon til læring slik jeg ser det.
Utvikling	Teorier om barns utvikling har blitt kraftig kritisert - derfor er det vanskelig for meg å bruke ordet. Det innebærer for meg ikke en statisk eller stadiemessig utvikling. Eller endimensjonal. Utvikling kan gå i ulike retninger – som en rhizome – slik Deleuze sier. Men noe skjer – en endring skjer. Dette ligger i utviklingsbegrepet for meg.

Læring	
Fag	Læring skjer innenfor et fag.
Kunnskap	Resultat av læring.
Erfaringer	Fører ofte til læring.
Opplevelser	Fører ofte til læring - nødvendig for læring.
Utforsking	Elevens vei mot læring.
Aktiviteter	En forutsetning for læring.

Appendix 6 Stimuli words overview: Source, informants and frequency

I conducted the word association test sessions with 12 teacher informants, as described in section 3.3. Three of the informants had two sessions, resulting in 15 sessions with a total duration of 20 hours. The informants performed 187 processings distributed on 117 unique stimuli words. The table below displays an overview of stimuli words used in the word association test with teacher informants (cf. section 3.3.2.2 for a description of the selection process). *Læring* 'learning', and *motivasjon* 'motivation' were the two stimuli words with the highest number of processings (8 and 6, respectively). Words which later appeared as work task facet terms in the simulated work tasks, are provided in italics.

I used two sources to find candidates for stimuli words. The first source came from teachers' input: Before the word association testing, the teacher informants were instructed to "put down at least 20 words from the topical area of pedagogy for which the students at the general school teacher education should become familiar with and should be able to give an account of during an examination". All the words provided by the informants are integrated in the table below, whether or not they were used as stimuli words. The second source of candidates for stimuli words was a set of previous examination tasks used at the same course of pedagogy as the one my student informants attended.

Explanation of the columns in the table below:
20pedWords: The 12 informants were coded A-L, followed by the digits 1 or 2 (to indicate first or second session), word number, and total number of words provided by the informant. Example of how to read the column: K1/22av23 means that this word was provided as the 22nd out of a total of 23 words by informant K in her first session.

Exam. task: This column indicates which words are found in the list of previous examination tasks which were used as candidates for stimuli words in addition to the "20pedWords".

Used as stimulus word: Indicates which informants who processed which stimuli words. Example of how to read the column: B2/3av18 means that this word was processed as the 3rd out of a total of 18 stimuli words processed by informant B in his second session.

Frequency: The number of times each word has been processed in the word association test.

	20pedWords	*Exam. task*	*Used as stimulus word*	*Frequ-ency*
Anerkjennende relasjon	K1/22av23			
Arbeidsformer		Exam. task	E2/11av13	1
Arbeidsmiljø		Exam. task	L1/4av8	1
Arbeidsmåter	E1/7av20			
Atferdsteorier	J1/12av21			
Atferdsvansker	J1/9av21 L1/11av20		K1/6av13	1
Attribusjonsteorier		Exam. task	G1/4av10	1
Avmakt	I1/5av20			
Barn	H1/1av23	Exam. task		
Barnehage	H1/2av23			
Barnevern	G1/12av20		H1/4av13	1
Barns medvirkning	K1/8av23			
Barns perspektiv	K1/19av23			
Basebarnehager	F1/16av20			
Behaviorisme	J1/13av21			
Danning	A1/2av20 D1/16av21 E1/9av20 I1/1av20 B1/4av20 L1/12av20	Exam. task	B1/3av18 B2/3av18 I1/9av13 B2/3av18 C1/5av12	4
Danningsteorier	J1/18av21			
Dekonstruksjon	H1/19av23 I1/19av20			
Deltakelse	G1/19av20	Exam. task		
Demokrati	G1/20av20 I1/13av20	Exam. task	H1/11av13	1
Dialektikk	G1/9av20 D1/18av21		K1/7av13	1
Dialektisk danning	J1/20av21			
Dialog	E1/13av20 I1/9av20			
Didaktikk	B1/8av20 C1/2av20 D1/6av21 E1/4av20 F1/6av20 J1/2av21 K1/6av23 L1/7av20		A1/1av12 B1/1av18 C1/1av12 D1/1av11 G1/1av10	5
Didaktisk relasjonstenking	L1/19av20			
Didaktiske modeller		Exam. task	H1/6av13	1
Differensiert undervisning			A1/12av12	1
Diskurser	G1/7av20 I1/16av20			

Dømmekraft	I1/12av20			
Elever		Exam. task	B2/16av18	1
Elevforutsetninger	C1/16av20 D1/17av21 J1/11av21	Exam. task	J1/6av13 L1/6av8	2
Elevroller	D1/15av21	Exam. task		
Elevsyn	J1/3av21			
Elevvurdering	C1/14av20	Exam. task	D1/8av11	1
Emosjonelle vansker		Exam. task	E2/10av13	1
Endringskompetanse	C1/9av20		E1/12av13	1
Enhetsskole [cf. Fellesskole]	*B1/13av20*	*Exam. task*	*B2/11av18*	*1*
Etikk	I1/2av20			
Etisk kompetanse		Exam. task	F1/2av12	1
Etniske minoriteter	G1/14av20		H1/7av13	1
Fag	E1/17av20			
Fagdidaktikk	G1/13av20			
Fagledere	F1/12av20			
Fellesskole [cf. Enhetsskole]	se Enh.skole	Exam. task	A1/11av12	1
Filosofi	I1/18av20			
Flerkultur	H1/21av23 K1/20av23 A1/11av20			
Flerkulturell pedagogikk	B1/19av20 J1/15av21		B2/14av18 E1/2av13 G1/3av10	3
Flerkulturell skole		*Exam. task*	*B1/13av18*	*1*
Foreldre-skole-samarbeid		Exam. task	L1/8av8	1
Foreldresamarbeid	A1/13av20 F1/19av20 H1/11av23 K1/12av23	Exam. task	B1/15av18 F1/5av12	2
Foreldreskap	G1/10av20		H1/9av13	1
Forhandling	G1/17av20			
Formal danning	J1/21av21			
Grunnlagsproblemer	B1/18av20		B2/18av18	1
Hjem-skole-samarbeid	C1/17av20	Exam. task	J1/9av13	1
Humanitet	I1/14av20			
Identitet	A1/1av20 B1/12av20 D1/20av21	Exam. task	B1/2av18 E2/5av13 H1/12av13 I1/10av13	4
Identitetskonstruksjon	K1/21av23			
Inkluderende opplæring		*Exam. task*		
Inkludering	*L1/5av20*	*Exam. task*		
Innhold	E1/6av20	Exam. task		
Kjønn			B2/15av18	1
Kjønn og pedagogikk	B1/20av20			
Kjønnssosialisering	C1/19av20		K1/13av13	1
Klasseledelse [cf. Klasseromsledelse]	B1/17av20	Exam. task	B2/12av18	2

	C1/10av20 D1/5av21		D1/6av11	
Klasseromsforskning	B1/16av20		B2/9av18	1
Klasseromsledelse [cf. Klasseledelse]	A1/7av20		B1/8av18	1
Kognitive teorier	A1/20av20		K1/8av13	1
Kommunikasjon	G1/4av20 H1/14av23 K1/2av23	Exam. task	H1/3av13	1
Kompetanse	E1/11av20	Exam. task		
Kompetansemål	C7/15av20		D1/10av11	1
Konflikt	F1/18av20			
Konflikthåndtering	K1/18av23			
Kultur	C7/5av20 H1/20av23		I1/2av13	1
Kulturell kompetanse		Exam. task	F1/7av12 I1/7av13	2
Kunnskap		Exam. task	L1/7av8	1
Kunnskapsløftet		*Exam. task*	*J1/11av13*	*1*
Kunnskapsnivåer		Exam. task		
Kunnskapssyn		Exam. task		
Kunnskapstilegnelse		Exam. task		
Ledelse	F1/5av20 G1/5av20 H1/13av23 K1/5av23		G1/5av10 K1/5av13	2
Lederroller	F1/11av20		H1/5av13	1
Lek	E1/15av20 G1/2av20 H1/6av23 K1/3av23	Exam. task	A1/4av12 E1/8av13 F1/3av12 G1/7av10 I1/1av13	5
Likestilling		Exam. task	B2/13av18 E1/4av13	2
Likeverd		*Exam. task*	*B2/17av18* *E2/3av13* *I1/13av13*	*3*
Likhet		*Exam. task*		
Læreforutsetninger		Exam. task	F1/1av12	1
Læremidler		Exam. task	A1/5av12	1
Læreplanarbeid	D1/13av21	Exam. task	G1/2av10	1
Læreplaner	J1/6av21		A1/9av12	1
Læreplantenkning	C1/12av20 D1/12av21			
Læreplanteorier	A1/3av20 B1/14av20 L1/18av20		B1/4av18	1
Læreplanverket for Kunnskapsløftet (LK06)	C1/11av20	Exam. task	D1/3av11	1
Lærere		Exam. task	J1/8av13	1

Lærerprofesjonalitet	A1/9av20 L1/15av20	Exam. task	B1/11av18	1
Lærerroller	A1/18av20 D1/14av21	Exam. task	D1/11av11 L1/5av8	2
Læring	*B1/2av20* *D1/2av21* *E1/1av20* *F1/1av20* *G1/6av20* *H1/5av23* *I1/8av20* *K1/4av23* *L1/2av20*	*Exam. task*	*A1/2av12* *B2/1av18* *C1/3av12* *D2/6av6* *E1/1av13* *G1/9av10* *H1/1av13* *K1/1av13*	*8*
Læringsmiljø	D1/9av21	Exam. task	D2/4av6	1
Læringsplakaten		Exam. task	J1/3av13	1
Læringspsykologi		Exam. task	F1/9av12	1
Læringssituasjoner		Exam. task	E2/1av13	1
Læringsstrategier	*J1/16av21*	*Exam. task*	*A1/7av12*	*1*
Læringsteorier	A1/5av20 J1/1av21	Exam. task	B1/6av18	1
Læringsutbytte		Exam. task	L1/2av8	1
Makt	I1/4av20			
Mandat/Oppdrag	E1/19av20			
Mangfold	I1/20av20	Exam. task	E2/9av13 I1/8av13	2
Material danning	J1/19av21			
Medvirkning	G1/18av20 H1/22av23		K1/11av13	1
Mestring		Exam. task	E2/12av13 F1/10av12 I1/12av13	3
Minoritetsspråklige elever	L1/9av20			
Mobbing		Exam. task	E1/5av13 F1/4av12	2
Motivasjon	*A1/12av20* *B1/10av20* *C1/20av20* *D1/3av21* *J1/5av21*	*Exam. task*	*A1/3av12* *B1/14av18* *C1/11av12* *D1/7av11* *E1/11av13* *J1/1av13*	*6*
Mål	E1/5av20 K1/16av23			
Mål-middel-tenking	L1/20av20			
Observasjon	H1/9av23 K1/10av23			
Omsorg	E1/2av20 F1/9av20 G1/1av20 I1/7av20		G1/10av10 H1/2av13 K1/4av13	3

Oppdragelse	B1/6av20 E1/3av20 L1/1av20		B2/5av18 C1/7av12	2
Opplæring	F1/14av20	Exam. task	E2/8av13	1
Oppvekst	L1/3av20	Exam. task		
Oppvekstvilkår	C1/5av20		D1/4av11	1
Organisasjon	F1/7av20	Exam. task		
Pedagogikk	D1/1av21		A1/10av12 B1/10av18 C1/10av12 D2/1av6 I1/4av13	5
Pedagogisk dokumentasjon	H1/8av23 K1/9av23			
Pedagogisk kompetanse			F1/11av12 F1/13av12	2
Pedagogisk psykologi	C1/1av20		D1/9av11	1
Pedagogisk utviklingsarbeid	K1/11av23			
Pedagogiske verktøy			E1/3av13	1
Personalledelse	H1/12av23			
Personaloppfølging	G1/16av20			
Personalsamarbeid	F1/20av20 K1/13av23			
Politikk	I1/11av20			
Poststrukturell tilnærming	H1/18av23			
Praksis	F1/17av20			
Problematferd		Exam. task	F1/8av12	1
Profesjon	E1/18av20			
Profesjonalitet		Exam. task	E2/4av13	1
Den proksimale utviklingssone [cf: Sonen for nærmeste utvikling]	B1/7av20		B2/6av18	1
Psykoanalytiske teorier			L1/3av8	1
Pygmalioneffekten		Exam. task	J1/5av13	1
Rammeplaner	F1/10av20			
Refleksjon	G1/8av20 I1/15av20	Exam. task	H1/8av13 K1/2av13	2
Relasjoner	E1/10av20 H1/16av23 I1/3av20	Exam. task	K1/12av13	1
Relasjonsforståelse	D1/4av21			
Relasjonskompetanse	H1/17av23		I1/5av13 J1/10av13	2
Retorikk	I1/6av20			
Risikoutsatte barn og unge	L1/10av20			
Samarbeid	E1/12av20 G1/11av20 H1/15av23	Exam. task	I1/11av13	1
Samhandling	G1/3av20		H1/13av13	1
Samspill	F1/3av20		K1/9av13	1

	F1/15av20 I1/10av20 K1/1av23			
Selvoppfatning	B1/11av20 D1/19av21		B2/8av18 C1/12av12	2
Selvutvikling	K1/23av23			
Skole		Exam. task	D2/5av6	1
Skole-hjem-samarbeid	L1/17av20	Exam. task		
Skolebasert vurdering	A1/16av20 C1/13av20		D1/2av11	1
Skolehistorie	A1/8av20 C8/1av20 J1/17av21		B1/9av18 D1/5av11	2
Skolekoder		Exam. task	J1/7av13	1
Skolekultur	D1/7av21	Exam. task	D2/2av6	1
Skolen som arena	D1/11av21			
Skolen som institusjon	C1/6av20			
Skoleutvikling		Exam. task	J1/13av13	1
Sonen for nærmeste utvikling [cf. Den proksimale utviklingssone]	cf. Proksim.		C1/8av12	1
Sosial kompetanse	C1/3av20 K1/7av23	Exam. task	E2/6av13	1
Sosial læringsteori	J1/14av21			
Sosiale vansker		Exam. task	E2/2av13	1
Sosialisering	A1/4av20 B1/1av20 C1/4av20 H1/3av23 J1/10av21 L1/4av20		B1/5av18 C1/2av12 E1/9av13	3
Sosialiseringsprosesser	D1/21av21		G1/8av10	1
Sosiokulturelle teorier	A1/17av20		B1/18av18	1
Spesialpedagogikk	G1/15av20 J1/8av21 L1/14av20		E1/6av13 H1/10av13	2
Spesialpedagogisk kompetanse	D1/10av21		K1/10av13	1
Spesialpedagogisk opplæring	A1/19av20			
Språk	E1/16av20 I1/17av20	Exam. task	F1/12av12 I1/3av13	2
Språkstimulering	H1/10av23		J1/4av13	1
Tidlig stimulering	F1/4av20	Exam. task	I1/6av13	1
Tilpasset opplæring	A1/14av20 D1/8av21 J1/4av21 L1/6av20	Exam. task	B1/16av18 D2/3av6 E1/13av13	3
Tradisjon/Historie	E1/20av20			
Trivsel		Exam. task		
Undervisning	*B1/5av20*	*Exam. task*	*A1/6av12*	*3*

			B2/7av18 *C1/6av12*	
Undervisningsaktiviteter	A1/6av20	Exam. task	B1/7av18	1
Undervisningsformer		Exam. task	L1/1av8	1
Undervisningsmetoder		Exam. task	A1/8av12	1
Ungdomskultur	B1/15av20		B2/10av18	1
Ungdomssosialisering	C1/18av20			
Utdanning		Exam. task	G1/6av10 J1/12av13	2
Utvikling	B1/3av20 F1/2av20 H1/4av23	Exam. task	B2/2av18 C1/4av12 E1/7av13	3
Utviklingspsykologi	L1/8av20			
Utviklingsstadier	B1/9av20		B2/4av18 C1/9av12	2
Veiledning	E1/14av20 F1/13av20 H1/23av23 K1/17av23		K1/3av13	1
Verdier		Exam. task	E2/13av13	2
Voksenroller	F1/8av20			
Vurdering	A1/15av20 E1/8av20 H1/7av23 J1/7av21 K1/15av23 L1/13av20	Exam. task	B1/17av18 E2/7av13 F1/6av12 J1/2av13	4
Yrkesetikk	K1/14av23 L1/16av20	Exam. task		
Yrkesetisk kompetanse	A1/10av20		B1/12av18 E1/10av13	2

Appendix 7 PedNett home entry vocabulary (stimuli and response words)

The PedNett home entry vocabulary contains the sum of words occurring as stimulus and/or response words (594, of which 117 were used as stimuli words) plus 36 references, a total of 630 terms. The interface of the PedNett database is to be found at http://bibin.hio.no/pednettphd/. The PedNett database can (at least until the PhD defence) be entered with the user name 'phdreader' and the password 'pedsearch'.

Cf. entry vocabulary on the next pages:

Aktiviteter
Aktivt arbeid med tradisjoner
Alder
Allmennetikk
Allsidighet
Anerkjennelse
Angst
Ansvar
Ansvar for egen læring
Antagelser om læring
Antitese
Arbeidsformer
Arbeidsmetoder
Arbeidsmiljø
Arbeidsmåter
Arbeidsredskaper
Argumentasjon
Atferdsproblemer
Atferdsvansker
Attribusjon
Attribusjonsteorier
Autoritative lærer (Den)
Autoritære lærer (Den)
Baksnakking
Balkanisering
Barn
Barn med funksjonshemninger
Barn med spesielle behov
Barndomsopplevelser
Barnemedvirkning
Barnevern
Barns egen uttrykksform
Begreper
Behavioristiske teorier
Behavioristiske tilnærminger til læring
Behov
Belønning
Bestemthet
Betinging
Bevissthet
Bidrag
Broen
Bruner
Dannelse
Danning
Delegering
Demokrati
Den autoritative lærer
Den autoritære lærer
Den didaktiske relasjonsmodellen
Den døde musens pedagogikk
Den proksimale utviklingssone
Depresjon
Diagnoser
Dialektikk
Dialog
Diamantmodellen
Didaktikk
Didaktiske modeller
Didaktiske relasjonsmodellen (Den)
Differensiering
Differensiert undervisning
Dilemmaer
Diskriminering
Diskurser
Dokumentasjon
Driv
Drivkrefter
Dømmekraft
Egenmotivasjon
Eget fagområde
Eksamener
Eksperimentering
Elev-/lærerforutsetninger
Elever
Elever i skolen
Elever og studenter og kunnskap
Elevers bevissthet rundt egen læring
Elevers læring
Elevers utvikling
Elevforutsetninger
Elevplanlegging
Elevvurdering
Emosjonelle vansker
Empati
Endringskompetanse
Enhetsledere
Enhetsskole
Erfaringer
Erikson
Ervervet kunnskap
Estetikk
Etikk
Etisk kompetanse
Etnisitet
Etniske minoriteter
Evaluering
Evalueringsformer
Evne til sosial kompetanse
Fag
Fagdidaktikk
Fagkunnskap
Faglig dyktighet
Faglighet

Fagrekker
Fellesskap
Fellesskole
Feminisme
Ferdigheter
Filosofi
Fleksibilitet
Flere gutter marginaliseres
Flerfaglighet
Flerkultur
Flerkulturell pedagogikk
Flerkulturell skole
Flerspråklighet
Folkestyre
Forandring
Fordypning
Foreldre-skole-samarbeid
Foreldremøter
Foreldreroller
Foreldresamarbeid
Foreldreskap
Forelesning
Forhold
Formell pedagogikk
Formell sosialisering
Formelle læreplaner
Formelle og uformelle sider
Forskjeller
Forskjeller i kultur og livsorientering
Forskjellsbehandling
Forståelse
Forståelse for holdninger når det gjelder foreldre og barn
Forståelse for normer og regler
Forutsetninger for læring
Forventninger
Fra kort til lang fellesskole
Freud
Frilek
Frivillighet
Funksjonsevne
Funksjonshemmede barn
Funksjonshemming
Fysisk omsorg
Følelsesmessige vansker
Gamle og nye minoriteter
Gammeldagse begreper
Generasjonsforhold
Generelle prinsipper
Gi
Gjenstander
Gjøre felles
Gjøre sammen
Glede
Global verden
Gradert måloppnåelse
Gradvis utvikling
Grunnlagsproblemer i pedagogikk
Grunnlagsspørsmål
Grunnleggende ferdigheter
Gruppearbeid
Grupper
Gutter marginaliseres
Gutter og jenter
Gå foran
Hamarmodellen
Hargreaves
Helklasseundervisning
Hensikt
Hjelp for foreldre
Hjem-skole-samarbeid
Hjemmets oppgaver
Hjernen
Hode, hånd, hjerte
Holdninger
Humanitet
Humor
Hvem er jeg
Identitet
Identiteter
Identitetsarbeid
Ikke parallellskoler
IKT
Immigrasjon
Individer
Individpsykologi
Individualisering
Individualitet
Individuell opplæringsplan (IOP)
Individuelle forutsetninger
Individuelt arbeid
Individuering
Indre motivasjon
Indre/ytre motivasjon
Informasjons- og kommunikasjonsteknologi (IKT)
Inkludering
Innflytelse
Innhold
Innlevelse
Innovasjon
Innsikt
Inspirasjon
Instruksjon

Instruktører
Integrering
Intellektuell og sosial
Interesser
IOP
Irritasjon
Jenter og gutter
Jevnalderfellesskap
Jevnaldrende
Kapital
Karakterer
Kartlegging
Kaste tilbake
Kategorier
Kategorisering
Kjønn
Kjønnsroller
Kjønnssosialisering
Klasseledelse
Klasseledelse som relasjonsforståelse
Klasseledere
Klasseoffentlighet
Klasserom
Klasseromsforskning
Klasseromsledelse
Klasseromsorganisering
Klima
Kognitiv konstruktivisme
Kognitiv psykologi
Kognitive teorier
Kommunikasjon
Kompetanse
Kompetanseheving
Kompetansemål
Kompetanseutvikling
Konstruert identitet
Konstruksjoner
Konstruksjonslek
Kontekst
Kontroll
Kort og lang ungdomstid
Krav i skolen
Kritikk
Kritisk refleksjon
Kritisk tenkning
Kroppsbevegelser
Kultur
Kulturarv
Kulturell forståelse
Kulturell kompetanse
Kulturelle oppvekstvilkår
Kulturmangfold
Kunnskap
Kunnskap som forandrer
Kunnskapsløftet
Kunnskapsmåling
Kunnskapsområder
Kunnskapsoversikt
Kvalifisering
Kvalitet
Kvener
Kvinnedominans i skolen
Ledelse
Lederroller
Lederstiler
Lek
Lekteorier
Lesing
Likestilling
Likeverd
Likhet
Livets skole
Livslang læring
Livslangt foreldreskap
Livsvalg
LK06
Lov og forskrifter, læreplaner
Lundgren
Lyst
Lytting
Lærebøker
Læreforutsetninger
Læremidler
Læren om læring
Læren om oppdragelse
Læren om undervisning
Læren om utvikling
Lærende organisasjoner
Læreplanarbeid
Læreplaner
Læreplanhistorie
Læreplanstadier
Læreplanteorier
Læreplanutvikling
Læreplanverket for Kunnskapsløftet (LK06)
Lærerarbeid
Lærere
Læreren som aktør
Læreren som den ansvarlige
Læreren som leder av elevenes læringsarbeid
Læreren som privat og personlig skikkelse
Læreren som profesjonell
Lærerkompetanse

Lærerplanlegging
Lærerprofesjonalitet
Lærerroller
Læring
Læringsforutsetninger
Læringsmiljø
Læringsplakaten
Læringsprosesser
Læringspsykologi
Læringsresultater
Læringssituasjoner
Læringsstiler
Læringsstrategier
Læringssyn
Læringsteorier
Læringsutbytte
Majoriteter
Makro- og mikropedagogikk
Makt
Mandat
Mangfold
Mangfold og fellesskap
Manglende motivasjon
Marginalisering
Matematikkdidaktikk
Medbestemmelse
Medelever
Mediering
Medvirkning
Mening
Mennesker
Menneskesyn
Menneskeverd
Mestring
Mestringsmotivasjon
Metakognitive læringsstrategier
Metoder
Migrasjonspedagogikk
Minoriteter
Minoriteter fra andre land
Mobbing
Modernismeprosjektet
Motivasjon
Motsetninger
Motta
Muligheter
Muligheter for læring
Muliti-identiteter
Mønster for samhandling
Mål
Måling
Måling av kunnskap
Måloppnåelse
Målvurdering
Nasjonale prøver
Natur
Nedsatt funksjonsevne
Nordahl
Normalvariasjon
Normer
Normer og regler
Nytenkning
Nærmiljø
Offentlig skole
Offentlighet
Omsorg
Omsorgssvikt
Oppdrag
Oppdragelse
Opplevelser
Opplæring
Oppvekstvilkår
Organisatorisk differensiering
Organisering
Overbevisningskunst
Overgangsaktiviteter
Overordnet mål
Overskridelser
Parallell lek
Parallellskoler
Pedagogikk
Pedagogisk filosofi
Pedagogisk kompetanse
Pedagogisk psykologi
Pedagogisk takt
Pedagogiske ledere
Pedagogiske verktøy
Personligheter
Piaget
Pisa
Planlegging
Praksis
Praksisteorier
Praktisk dyktighet
Prestasjonsmotivasjon
Primær sosialisering
Problematferd
Problemer
Profesjonalitet
Profesjonell fantasi
Profesjoner
Profesjonsstudier
Proksimale utviklingssone (Den)
Prosjektarbeid

Prososiale ferdigheter
Prøver
Psykisk omsorg
Psykiske vansker
Psykoanalytiske teorier
Psykoanalytiske tilnærminger til læring
Psykologi
Psykologisk teori
Psykose
Pygmalioneffekten
Rammefaktorer
Rammer og handlerom
Rasjonalitet
Refleksjon
Regelsett
Regler
Regler og normer
Relasjoner
Relasjonskompetanse
Relasjonsmodellen
Religion
Reproduksjon av sosiale ulikheter
Respekt
Respekt for medelever
Respekt for undervisningspersonalet
Ressursorientering
Retningslinjer
Rettferdighet
Rettigheter
Rettigheter og plikter
Rollelek
Roller
Roller i klasserommet
Rolletaking
Romfolket
Ros
Rosenthaleffekten
Rutiner
Samarbeid
Samarbeidskulturer
Samarbeidsrelasjoner
Samer
Samfunn
Samfunnsskapt kjønnssosialisering
Samfunnsutvikling
Samhandling
Samling
Samlingsstunder
Sammenhengen mellom læring, kognitiv og psykologisk utvikling
Sammenhenger
Samspill
Samtidsanalyse
Se alle fag
Seksualitet
Sekundær sosialisering
Self-efficacy
Selvbilde
Selvforståelse
Selvhevdelse
Selvkonstruert identitet
Selvkontroll
Selvoppdragelse
Selvoppfatning
Selvregulert læring
Selvstendighet
Selvstudium
Setningsoppbygging
Sigøynere
Situasjonsorientert ledelse
Skole
Skole for alle
Skole-hjem-samarbeid
Skolebasert vurdering
Skolegang
Skolehistorie
Skolehverdagen
Skolekoder
Skolekultur
Skoleledelse
Skolen som en avgjørende og veldig betydningsfull arena i barnets oppvekst
Skolen som en plass for alle
Skolen som organisasjon
Skolens oppgaver
Skolens vurdering av elevens læring
Skoleutvikling
Skriving
Snøballeffekten
Sonen for nærmeste utvikling
Sosial danning
Sosial kompetanse
Sosial læring
Sosial mestring
Sosiale forskjeller
Sosiale oppvekstvilkår
Sosiale relasjoner
Sosiale vansker
Sosiale/faglige kompetansemål
Sosialisering
Sosialiseringskonflikter
Sosialiseringsprosesser
Sosialkonstruktivisme
Sosialpsykologi

Sosiokulturelle forutsetninger
Sosiokulturelle teorier
Sosiokulturelle tilnærminger til læring
Speiling
Spesialpedagogikk
Spesialpedagogisk kompetanse
Spesialpedagogiske behov
Spesielle behov
Spontanitet
Språk
Språkstimulering
Språkutvikling
Spørsmål-svar
St.meld. nr. 30 (2003-2004) Kultur for læring
Stadier
Stadieteorier
Standarder
Stasjonspedagogikk
Stillasbygging
Stimuli
Store endringer
Stortingsmeldingen om skolen (Kunnskapsløftet)
Studentaktivitet
Styrere
Subjekt
Subjektivitet
Syn på læring
Syntese
Systematisk pedagogikk
Systemer
Ta hensyn til og se
Ta vare på
Tapere
Tavleundervisning
Temaarbeid
Tenkning
Teorier
Tese
Testing
Tidlig stimulering
Tilbakemeldinger
Tillit
Tilpasset opplæring (TPO)
Tilpasset opplæring som det å tenke både individ og felleskap samtidig
Tilpasset opplæring som en intensjon
Tilpasset opplæring som en visjon
Tilpasset opplæring som et altoverskyggende prinsipp i den norske skolen
Tilpasset opplæring som et politisk begrep
Tilrettelagt undervisning
Tilretteleggere av læring
Toleranse
TPO
Tradisjonell kulturvariasjon
Tradisjonsbevissthet
Trening
Trivsel
Troll i ord
Trondheimsmodellen
Trusler
Tydelighet
Uetisk oppførsel
Uformell pedagogikk
Uformell sosialisering
Uformell vurdering
Ulike arbeidsmåter
Ulike personligheter
Ulike roller i klasserommet
Ulike typer lek
Underveisvurdering
Undervisere
Undervisning
Undervisningsaktiviteter
Undervisningsformer
Undervisningslære
Undervisningsmateriell
Undervisningsmetoder
Undervisningsmønstre
Undervisningspersonale
Undervisningsplanlegging
Undervisningspraksis
Undervisningsteorier
Ungdomskultur
Utdanning
Utdanning gir muligheter
Utdanningspolitikk
Utdanningsvitenskap
Utestenging
Utfordrende samarbeid
Utforsking
Uttrykk
Utvikling
Utviklingspsykologi
Utviklingssamtaler
Utviklingsstadier
Vansker
Vegring
Veiledere
Veiledning
Veisøkere

Vekst
Verdier
Vinnere
Voksenroller
Voldsbruk
Vurdering
Vurdering for læring
Vygodskij og sosialkonstruktivisme
Vygotskij
Yrkesetikk
Yrkesetisk kompetanse
Ytre motivasjon
Økonomiske oppvekstvilkår
Øvelse
Åpenhet

Appendix 8 PedNett clusters with all related word entries compressed

Three examples are provided below: The first example contains the largest PedNett cluster, i.e. the one for *læring* 'learning', which was processed as stimulus word by 8 teacher informants. This is followed by two examples of smaller PedNett clusters, i.e. for *elever* 'pupils', processed by 1 informant, and *estetikk* 'aesthetics', which was never processed as stimulus word, and occurred only once as response word.

Læring

Til PedNett startside

Utvid alle Krymp alle

Lek
+
Kunnskap
+
Motivasjon
+
Kognitiv konstruktivisme
+
Læringspsykologi
+
Mestring
+
Sosialisering
+
Sosialkonstruktivisme
+
Utvikling
+
Aktiviteter
+
Behavioristiske teorier
+
Behavioristiske tilnærminger til læring
+
Danning
+
Elever og studenter og kunnskap
+
Elevforutsetninger
+
Erfaringer
+
Fag
+
Ferdigheter
+

Forandring
+
Forståelse
+
Holdninger
+
Individer
+
Innsikt
+
Kognitiv psykologi
+
Kognitive teorier
+
Kommunikasjon
+
Kompetanseheving
+
Kunnskapsoversikt
+
Kvalifisering
+
Læreforutsetninger
+
Lærere
+
Læringsteorier
+
Læringsutbytte
+
Mål
+
Opplevelser
+
Pedagogikk
+
Psykoanalytiske tilnærminger til læring
+
Relasjonskompetanse
+
Sosiokulturelle tilnærminger til læring
+
Testing
+
Utforsking
+
Vurdering
+

Til PedNett startside

Elever[48]

Til PedNett startside

Utvid alle Krymp alle

Elever i skolen
+
Formelle og uformelle sider
+
Jevnalderfellesskap
+

Til PedNett startside

Estetikk[49]

Til PedNett startside

Utvid alle Krymp alle

Kultur
+

Til PedNett startside

[48] *Elever* ‘pupils’ was processed by 1 informant, who provided 3 associations and relationship descriptions.
[49] *Estetikk* ‘aesthetics’ was never processed as stimulus word, and occurred only once as response word. This becomes apparent in appendix 10, when the associated word *Kultur* ‘culture’ is expanded by clicking the plus sign ‘+’, which is then replaced by a *left* arrow *‘←’* and a relationship description.

Appendix 9 PedNett clusters with one related word entry expanded

Two examples are provided below, with the first related word in each example expanded: The first example contains the PedNett cluster for *læring* ‘learning’, with the relationship descriptions for *lek* ‘play’ expanded. Second, the PedNett cluster for *lek*, as an ‘inverted’ example, to illustrate how the right and left arrows indicate the direction of the associative relationship. A right arrow ‘→’ in front of the first relationship description for *lek* indicates a relationship description between the entry term *læring* as stimulus word and the expanded term *lek* as response word, whereas left arrows ‘←’ in front of the following relationship descriptions indicate the opposite, i.e. *lek* as stimulus word with *læring* as response word. We note that the right directed arrows are always listed first.

Læring

Til PedNett startside

Utvid alle Krymp alle

Lek

–

→ Lek og læring har sammenheng med hverandre i barnehagen. Dette har med at barnas uttrykksform ofte er lekpreget aktivitet i småbarnalder. Det er derfor kunstig å sette lek og læring opp som motsetninger til hverandre. Mange prosjekter barna kan arbeide med gjøres ved hjelp av lekpreget og kreativ aktivitet der barn får uttrykke seg og komme med egne ideer og assosiasjoner. Reproduksjon av kunnskap som den voksne sitter inne med bør ikke ha stort omfang i barnehage.

← Lek og læring er to ord som henger sammen. Lek er et godt verktøy å lære i gjennom.

← Det skjer mye læring i lek.

← Barna lærer gjennom leken.

← Det er gjennom lek at barn lærer innen alle områder.

Kunnskap

+

Motivasjon

+

Kognitiv konstruktivisme

+

Læringspsykologi

+

etc.

Lek

Til PedNett startside

Utvid alle Krymp alle

Lek

–

→ Lek og læring er to ord som henger sammen. Lek er et godt verktøy å lære i gjennom.

→ Det skjer mye læring i lek.

→ Barna lærer gjennom leken.

→ Det er gjennom lek at barn lærer innen alle områder.

← Lek og læring har sammenheng med hverandre i barnehagen. Dette har med at barnas uttrykksform ofte er lekpreget aktivitet i småbarnalder. Det er derfor kunstig å sette lek og læring opp som motsetninger til hverandre. Mange prosjekter barna kan arbeide med gjøres ved hjelp av lekpreget og kreativ aktivitet der barn får uttrykke seg og komme med egne ideer og assosiasjoner. Reproduksjon av kunnskap som den voksne sitter inne med bør ikke ha stort omfang i barnehage.

Frilek

+

Rollelek

+

Barn

+

Barns egen uttrykksform

+

etc.

Appendix 10 PedNett clusters with all related word entries expanded

Three examples are provided below, i.e. the same PedNett clusters which were used (in compressed version) in appendix 8: *læring* 'learning' (8 processings), *elever* 'pupils' (1 processing), and *estetikk* 'aesthetics', which was never processed as stimulus word, and occurred only once as response word. In the examples below, all related word entries are expanded, meaning that all the relationship descriptions are displayed.

We note that the associated words in each *PedNett cluster* are ranked according to decreasing frequency, whereas all the word pairs made only once are displayed in alphabetical order.

The right and left arrows indicate the direction of the associative relationship. A right arrow '→' in front of the first relationship description for *lek* indicates a relationship description between the entry term *læring* as stimulus word and the expanded term *lek* as response word, whereas left arrows '←' in front of the following relationship descriptions indicate the opposite, i.e. *lek* as stimulus word with *læring* as response word. We note that the right directed arrows are always listed first.

Læring

Til PedNett startside

Utvid alle Krymp alle

Lek

–

→ Lek og læring har sammenheng med hverandre i barnehagen. Dette har med at barnas uttrykksform ofte er lekpreget aktivitet i småbarnalder. Det er derfor kunstig å sette lek og læring opp som motsetninger til hverandre. Mange prosjekter barna kan arbeide med gjøres ved hjelp av lekpreget og kreativ aktivitet der barn får uttrykke seg og komme med egne ideer og assosiasjoner. Reproduksjon av kunnskap som den voksne sitter inne med bør ikke ha stort omfang i barnehage.

← Lek og læring er to ord som henger sammen. Lek er et godt verktøy å lære i gjennom.

← Det skjer mye læring i lek.

← Barna lærer gjennom leken.

← Det er gjennom lek at barn lærer innen alle områder.

Kunnskap

–

→ Resultat av læring.

→ Endring fra lek til læring. I rammeplan for barnehager er læring nevnt 79 ganger mens lek er nevnt 70 ganger - altså tendens til et brudd og at læring gis større betydning enn tidligere.

→ Viser til en type læringsinnhold som er kognitivt.

← Det som skaper forståelse, mening hos eleven. Ulike forståelser av kunnskap avhengig av hvordan man tenker at læring skjer. I et behavioristisk perspektiv er kunnskap sett som en gitt størrelse som kan overføres til eleven, mens konstruktivistiske læringsperspektiv er opptatt av at læring er noe som skapes i den enkelte (kognitiv konstruktivisme) eller i rommet mellom mennesker (sosialkonstruktivisme).

Motivasjon

–

→ Læring og motivasjon henger sammen ved at motivasjon er en forutsetning for at det skal skje læring.

← Motivasjon er ofte en forutsetning for læring. God motivasjon gir ofte økt læring, mens dårlig motivasjon gir dårlige forutsetninger for læring.

← Motivasjon er en viktig forutsetning for elevers læringsarbeid og læring i skolesammenheng. Derfor er det nær sammenheng mellom en del læringsteorier og teorier om motivasjon og selvoppfatning.

← Motivasjon fremmer og letter læring.

Kognitiv konstruktivisme

–

→ Læring ses på gjennom kognitiv konstruktivisme som at det er individet selv som driver læringen forover.

→ Hva betyr det når vi tenker oss at kunnskapen og menneskets læring skjer som et ledd i en konstruksjon av erfaringer.

Læringspsykologi

–

→ Et stort og omfattende område som danner grunnlag for å forstå hva læring og læringsprosesser kan være.

← Læringspsykologi er læren om hvordan mennesket lærer.

Mestring

–

← Kanskje er læring – mestring – å få til noe – synonymer.

← Opplevelse av ikke å mestre, hemmer kreativitet og læring.

Sosialisering

–

→ Sosialisering viser til kontekster individet lærer i og hvem det er som påvirker individet i læringsprosessen.

→ Det å vokse inn i en institusjon eller samfunn er ofte det vi forstår med sosialisering. Dette skjer enten man ønsker det eller ei. Men det er forskjell på tilpassende sosialisering eller dannende sosialisering. Den sistnevnte har sterk relasjon til læring slik jeg ser det.

Sosialkonstruktivisme

–

→ Læring innen sosialkonstruktivismen foregår innenfor en sosial ramme. Individet lærer gjennom sosial deltakelse.

→ Dette har vært toneangivende i forhold til læringssyn, særlig i forhold til mye fagdidaktikk. Viktig at vi også her behandler ulike sider ved temaet.

Utvikling[50]

–

→ Barn forstås ut fra en stadietenking – Piaget – der de ulike nivåene for tilegnelse og læring settes som forutsetninger for hva barn kan.

[50] This is the last associated word which is sorted according to decreasing frequency.

→ Teorier om barns utvikling har blitt kraftig kritisert - derfor er det vanskelig for meg å bruke ordet. Det innebærer for meg ikke en statisk eller stadiemessig utvikling. Eller endimensjonal. Utvikling kan gå i ulike retninger – som en rhizome – slik Deleuze sier. Men noe skjer – en endring skjer. Dette ligger i utviklingsbegrepet for meg.

Aktiviteter[51]

–

→ En forutsetning for læring.

Behavioristiske teorier

–

→ Dette er et delområde innenfor læringspsykologien som spiller en stor rolle i det praktiske læringsarbeidet, men som har kommet i diskreditt. Viktig å behandle i forhold til etikk.

Behavioristiske tilnærminger til læring

–

→ Hvilke fordeler og hvilke sider ved en behavioristisk tilnærming kan vi dra nytte av i våre intensjoner om å utarbeide et undervisningstilbud som styrker elevens læring? Hva er ros og belønning i motsetning anerkjennelse?

Danning

–

→ Danning tar utgangspunkt i hvordan individet tilegner seg læring. Tre former for danning: formal, material og dialektisk danning. De ser ulikt på hvordan læringsprosessen og danningsprosessen forløper. alt fra at det er individet som utvikler seg selv og lærer denne veien, det er lærer som styrer og gir fagkunnskap og så det at barnet lærer og dannes gjennom en miks av formal og kategorial danning som er at man tar hensyn til både individet og fag i læringsprosessen.

Elever og studenter og kunnskap

–

→ Fokus for læring i skolesammenheng er samspillet mellom undervisning og elevenes kunnskapsutvikling.

etc.

Next page: PedNett clusters for *elever* ‘pupils’ (1 processing), and *estetikk* ‘aesthetics’ (occurred only once, as response word).

[51] This and all the following associated words are sorted alphabetically.

PedNett clusters for *elever* ‘pupils’ (1 processing), and *estetikk* ‘aesthetics’ (occurred only once, as response word):

Elever

Til PedNett startside

Utvid alle Krymp alle

Elever i skolen

–

→ Elev kommer av å løfte opp – elever er de som løftes opp til voksenlivet gjennom skolegang.

Formelle og uformelle sider

–

→ Å være elev gir barn og unge tildelte plasser med mange formelle sider som en ikke kan velge vekk. Elever møter skolens krav med ganske ulike strategier med typiske ytterpunkt som tilpassing, stille utmelding eller tilbaketrekking, eller åpen motstand og opposisjon.

Jevnalderfellesskap

–

→ Elever er sjelden alene i skoletida og skoler blir hovedramme for utvikling av mange og ulike jevnalderfellesskap og vennskap.

Til PedNett startside

Estetikk[52]

Til PedNett startside

Utvid alle Krymp alle

Kultur

–

← De estetiske fagene bidrar til kulturforståelse.

Til PedNett startside

[52] *Estetikk* ‘aesthetics’ was never processed as stimulus word, and occurred only once as response word. This is indicated by the *left* arrow *‘←’* in front of the relationship description for *Kultur* ‘culture’.

Appendix 11 Pre-session questionnaire of Revealment study

Spørreskjema til undersøkelse om studenters bruk av pedagogisk terminologi

Dette skjemaet fylles ut av deg som skal delta i Grete Selands undersøkelse om hvordan studenter velger stikkord når de skal planlegge ped-oppgaver og søke etter informasjon. Skjemaet leveres i forbindelse med hovedundersøkelsen som er 5., 6. eller 7. mai 2009, det vil si den dagen du selv har ped-undervisning.

Alle data blir anonymisert. Når du oppgir navn her, er det for å koble dette spørreskjemaet til det du kommer til å jobbe med i hovedundersøkelsen. Deretter slettes navnet ditt i datamaterialet.

Navn: ____

E-post: ____

Alder: ________________

Kjønn: ________________

Hva er ditt morsmål (eventuelt dine morsmål, hvis flerspråklig)?

____

Har du studert pedagogikk andre steder enn ved allmennlærerutdanningen (spesifiser)?

____

Hvor mange år har du brukt Google eller andre søkemaskiner på Internett (sett kryss)?

☐ Aldri. ☐ Mindre enn 1 år. ☐ Mellom 1 og 3 år. ☐ Mellom 4 og 6 år. ☐ 7 eller mer.

Hvor ofte søker du på Google eller andre søkemaskiner?

☐ Aldri. ☐ 1-2 ganger i året. ☐ 1-2 ganger i måneden. ☐ 1-2 ganger i uka. ☐ Oftere/daglig.

Hvor ofte søker du i elektroniske bibliotekkataloger, for eksempel Bibsys eller katalogen på folkebiblioteket?

☐ Aldri. ☐ 1-2 ganger i året. ☐ 1-2 ganger i måneden. ☐ 1-2 ganger i uka. ☐ Oftere/daglig.

Hvor ofte søker du i elektroniske baser for tidsskriftartikler, for eksempel ERIC-basen via Læringssenterets (bibliotekets) nettsider?

☐ Aldri. ☐ 1-2 ganger i året. ☐ 1-2 ganger i måneden. ☐ 1-2 ganger i uka. ☐ Oftere/daglig.

Side. 1 av 4

Hvor enkelt eller vanskelig synes du det er å velge hvilke stikkord du vil søke på når du bruker Internett, bibliotekkataloger eller tidsskriftbaser for å finne informasjon til noe du jobber med i forbindelse med studiet?

☐ Veldig enkelt. ☐ Enkelt. ☐ Nøytral. ☐ Vanskelig. ☐ Veldig vanskelig.

Eventuell utfyllende kommentar: ____

Hvis du gjør et søk og ikke finner det du er ute etter (for eksempel fordi du får ingen eller tusenvis av treff), hvor enkelt eller vanskelig synes du det er å komme på andre stikkord du kan bruke i et nytt søk?

☐ Veldig enkelt. ☐ Enkelt. ☐ Nøytral. ☐ Vanskelig. ☐ Veldig vanskelig.

Eventuell utfyllende kommentar: ____

Hva synes du er hovedutfordringen ved å søke etter informasjon på Internett eller i databaser?

Når du skal skrive en oppgave i forbindelse med studiet, hvordan pleier du da å skaffe den informasjonen du trenger? Du kan sette flere kryss.

☐ Søker på Google eller andre søkemaskiner på Internett.

☐ Bruker pensum i faget.

☐ Bruker forelesningsnotater.

☐ Diskuterer med medstudenter eller andre jeg kjenner.

☐ Søker i Bibsys eller andre bibliotekkataloger.

☐ Søker i elektroniske baser for tidsskriftartikler, for eksempel ERIC-basen.

☐ Låner bøker eller annet materiell på Læringssenteret (biblioteket) eller andre bibliotek.

☐ Bruker de trykte tidsskriftene på Læringssenteret eller andre bibliotek.

☐ Spør om hjelp på Læringssenteret eller andre bibliotek.

☐ Bruker oppslagsbøker.

☐ Bruker aviser, TV eller radio.

☐ Andre måter, spesifiser: ____

Angi i prosent i hvor stor grad du anser at følgende kriterier påvirker ditt valg av informasjon:
Når jeg skal skaffe meg informasjon i forbindelse med oppgaver på studiet, er det viktig for meg å finne:

Noen få dokumenter som handler om akkurat det jeg skal skrive om __________%

Mange dokumenter som i det minste til en viss grad har med emnet mitt å gjøre __________%

Det samlede prosenttallet bør bli 100 %

Side. 2 av 4

Spørsmål knyttet til hvordan du opplever studiene dine

Her følger noen utsagn som beskriver hvordan studenter kan oppleve studiene sine.

Vennligst ta hensyn til følgende når du bestemmer deg for svaralternativ:
- Svar ut fra **hvordan du opplever din nåværende studiesituasjon** som student på **allmennlærerutdanningen**.
- Gi din **umiddelbare respons** (det er ingen fasitsvar).
- Vennligst svar på **alle utsagn**. Sett ring rundt det alternativet som gjelder for deg.

Svar i hvor stor grad du er enig/uenig i at hvert av utsagnene passer til å beskrive deg i din studiesituasjon.

5 betyr enig **4 = i noen grad enig** **2 = i noen grad uenig** **1 = uenig**

Forsøk å unngå bruk av 3 (= usikker) med mindre du virkelig må eller dersom utsagnet ikke passer med din studiesituasjon.

1. Jeg klarer å finne studieforhold som gjør at jeg lett kommer meg videre i studiearbeidet mitt.	5	4	3	2	1
2. Vanligvis har jeg som mål selv å forstå meningen i det vi skal lære.	5	4	3	2	1
3. Jeg vurderer fakta nøye, og prøver å trekke mine egne konklusjoner om det jeg studerer.	5	4	3	2	1
4. Det er viktig for meg å føle at jeg oppnår så gode eksamensresultater som jeg kan.	5	4	3	2	1
5. Jeg prøver å relatere ideer jeg kommer borti til andre emner eller studier så ofte jeg kan.	5	4	3	2	1
6. Jeg tror at jeg er ganske systematisk og organisert når jeg leser til eksamen.	5	4	3	2	1
7. Det er ikke mye av arbeidet her jeg finner interessant eller relevant.	5	4	3	2	1
8. Jeg studerer slik at jeg er best mulig forberedt på de eksmensoppgavene jeg tror vi kan få.	5	4	3	2	1
9. Mye av det jeg leser gir liten mening: Det er som usammenhengende biter av kunnskap.	5	4	3	2	1
10.Jeg bekymrer meg ofte for om jeg noen gang vil klare å håndtere studiearbeidet ordentlig.	5	4	3	2	1
11.Jeg mener at det å studere akademiske emner til tider kan være ganske spennende.	5	4	3	2	1
12.Jeg konsentrerer meg om å lære akkurat det som er nødvendig for å bestå eksamen.	5	4	3	2	1
13.Jeg jobber heller jevnt gjennom hele semesteret fremfor å la alt vente til siste liten.	5	4	3	2	1
14.Ideer i bøker eller artikler på pensum setter meg ofte på sporet av egne tankerekker.	5	4	3	2	1
15.Jeg legger mye innsats i lesingen min fordi jeg har bestemt meg for å gjøre det bra.	5	4	3	2	1
16.Jeg er opptatt av å finne ut hvilke eksamensoppgaver det er mulig å få.	5	4	3	2	1
17.Jeg interesserer meg egentlig ikke for dette studiet, men må ta det av andre grunner.	5	4	3	2	1
18.Før jeg tar fatt på en oppgave eller et problem, prøver jeg å finne ut noe om bakgrunnen.	5	4	3	2	1
19.Stort sett utnytter jeg godt den tiden jeg har til disposisjon i løpet av en dag.	5	4	3	2	1
20.Jeg har ofte vanskeligheter med å finne noe mening i det jeg skal huske.	5	4	3	2	1
21.Jeg ligger ofte våken og bekymrer meg over arbeid jeg tror jeg ikke vil klare.	5	4	3	2	1
22.Det er viktig for meg å være i stand til å følge argumentasjonen eller forstå årsakssammenhenger.	5	4	3	2	1
23.Jeg liker å bli fortalt nøyaktig hva jeg skal gjøre for å lære meg faget.	5	4	3	2	1
24.Noen ganger "tenner" jeg på akademisk emner og føler at jeg ville like å fortsette med studier.	5	4	3	2	1

Det er svært viktig at du besvarer **alle** spørsmålene: **Vennligst sjekk at du har gjort dette**,
før du fyller ut samtykkeerklæringen på neste side.

Side 3 av 4

Deltakelse i Grete Selands doktorgradsprosjekt, HiO/Bibin

Samtykkeerklæring for informant

Undersøkelsen handler om hvordan studenter velger stikkord når de skal planlegge ped-oppgaver og søke etter fagstoff. Du skal jobbe i tre kvarter ved en PC på et IKT-rom med oppgaver som likner tidligere gitte eksamensoppgaver i pedagogikk-faget. Du skal ikke besvare selve oppgaven i form av tekst, men jobbe med å velge aktuelle stikkord som kan brukes til å strukturere en god ped-oppgave og som utgangpunkt til informasjonssøk. Alle data i undersøkelsen blir anonymisert. Studentene som deltar får et gavekort på 150 kr til Penelope bokhandel.

Samtykkeerklæring:
Jeg har blitt informert om hva undersøkelsen går ut på. Mitt bidrag som deltaker omfatter spørreskjemaet som følger denne samtykkeerklæringen, samt en tre kvarters arbeidsøkt 5., 6. eller 7. mai 2009 der jeg skal bruke en base med pedagogiske termer mens jeg jobber med en oppgave. Jeg samtykker i at de innsamlede dataene kan brukes i Grete Selands doktorgradsprosjekt i anonymisert form.

Sted/dato: ______________________________

Underskrift: _____________________________

Tusen takk for at du tok deg til å fylle ut spørreskjemaet. Skjemaet leveres ved oppmøte til undersøkelsen 5., 6. eller 7. mai. Undersøkelsen kommer til å foregå mens klassene til Hanne Christensen, Harald Jarning og Elisabeth Bjørnestad har ped-undervisning på timeplanen i uke 19 (tirsdag 5. mai kl. 11:30-14:15, onsdag 6. mai kl. 08:30-11:15 og torsdag 7. mai kl. 11:30-14:15). I første og siste time disse dagene er det ped-undervisning på det vanlige klasserommet. Den midterste av ped-timene settes av til undersøkelsen, som foregår på IKT-rom B321 i Pilestredet 52.

Velkommen!

Hilsen Grete Seland

Appendix 12 Translation of pre-session questionnaire of Revealment study

Questionnaire for survey on students' use of pedagogic terminology

This form is to be completed by participants in Grete Seland's survey on how students choose keywords while planning assignments in pedagogy and search for information. The filled-in questionnaire should be delivered in connection with the informant sessions taking place on May 5th, 6th, or 7th 2009, i.e. the day your class is scheduled for lectures in pedagogy.

All the data will be treated anonymously. When you provide your name here, it is for the researcher to be able to connect this questionnaire to what you are going to work with in your informant session. Your name will then be deleted in the data material.

Name: ____

E-mail: ____

Age: _______________

Gender: _______________

What is your mother tongue (or your mother tongues, if multilingual)?

____

Have you studied pedagogy elsewhere than at the general teacher education (specify)?

____

How many years have you used Google or other search engines on the Internet (please tick off)?

☐ Never. ☐ Less than 1 year. ☐ Between 1 and 3 years. ☐ Between 4 and 6 years. ☐ 7 or more.

How often do you use Google or other search engines?

☐ Never. ☐ 1-2 times a year. ☐ 1-2 times a month. ☐ 1-2 times a week. ☐ More frequently/daily.

How often do you use online library catalogues, such as Bibsys or the catalogue at your public library?

☐ Never. ☐ 1-2 times a year. ☐ 1-2 times a month. ☐ 1-2 times a week. ☐ More frequently/daily.

How often do you use electronic article databases, such as the ERIC database via the Learning Centre's (i.e. the library) website?

☐ Never. ☐ 1-2 times a year. ☐ 1-2 times a month. ☐ 1-2 times a week. ☐ More frequently/daily.

Page 1 of 4

How easy or difficult do you think it is to choose which keywords you want to use when searching the Internet, library catalogues, or article databases to find information for an assignment in connection with your study?

☐ Very easy. ☐ Simple. ☐ Neutral. ☐ Difficult. ☐ Very difficult.

Any further comments: ____

If you perform a search and do not find what you are looking for (for example, because you get zero, or thousands of hits), how easy or difficult do you think it is to come up with alternative keywords which you can use in a search?

☐ Very easy. ☐ Simple. ☐ Neutral. ☐ Difficult. ☐ Very difficult.

Any further comments: ____

In your opinion, what is the main challenge in searching for information on the Internet or in databases?

When writing an assignment in connection with you studies, how do you normally obtain the information that you need? You can tick off several boxes.

☐ Searching Google or other search engines on the Internet.

☐ Use the course curriculum.

☐ Uses lecture notes.

☐ Discuss with my fellow students.

☐ Searching Bibsys or other library catalogues.

☐ Searching electronic article databases, such as the ERIC database.

☐ Borrow books or other material at the Learning Centre (library) or other libraries.

☐ Use the printed journals at the Learning Centre or other libraries.

☐ Ask for help at the Learning Centre or other libraries.

☐ Use reference books.

☐ Use newspapers, TV or radio.

☐ Other methods, please specify: ____

Please estimate a percentage of to what extent you consider that the following criteria affect your choice of information: When I search for information related to an assignment in connection with my studies, it is important for me to find:

A few documents about exactly what I want to write about __________ %

Many documents that at least to some extent is related to my topic __________ %

The total percentage should be 100 %

Appendix 12 Translation of pre-session questionnaire of Revealment study

Questions related to how you experience your studies

Below you will find some statements that describe how students can experience their studies.
Please consider the following before you select your alternative answer:

- Select your answer considering **how you experience your current situation** as a student at the **general teacher education programme**.
- Give your **immediate response** (there is no definitive answer).
- Please **answer all the statements**. Please encircle the option which applies to you.

Reply as to what extent you agree/disagree with each of the statements with respect to how well they describe you in your present situation of study.

5 means agree 4=some extent agree 2=some extent disagree 1=disagree

Try to avoid using 3 (=uncertain) unless you really need to, or if the statement does not fit with your situation of study.

1. I manage to find study conditions in which I easily get on with my work.	5	4	3	2	1
2. Generally, I aim at understanding the meaning of what I am supposed to learn.	5	4	3	2	1
3. I consider the facts carefully and try to draw my own conclusions about what I'm studying.	5	4	3	2	1
4. It is important for me to feel that I achieve as good examination results as I can.	5	4	3	2	1
5. I try to relate perspectives I am faced with to other topics or courses as often as I can.	5	4	3	2	1
6. I think I'm quite systematic and organized when I prepare for an examination.	5	4	3	2	1
7. There is not much work here which I find interesting or relevant.	5	4	3	2	1
8. I study in a manner which makes me as well prepared as possible for the exams I'm likely to get.	5	4	3	2	1
9. Much of what I read makes little sense to me: It seems as disjointed bits of knowledge.	5	4	3	2	1
10. I often worry about whether I will ever be able to handle my academic work properly.	5	4	3	2	1
11. I find that studying academic topics can, at times, be quite exciting.	5	4	3	2	1
12. I concentrate on learning exactly what is necessary for me to pass the examination.	5	4	3	2	1
13. I work steadily throughout the semester rather than pending the tasks until the last minute.	5	4	3	2	1
14. I often get new ideas from perspectives I find in curriculum books or articles.	5	4	3	2	1
15. I put a lot of effort into my reading because I'm determined to make good results.	5	4	3	2	1
16. I am keen on finding out which examination tasks I am likely to get.	5	4	3	2	1
17. I am not actually very interested in this study, but I have to go ahead with it for other reasons.	5	4	3	2	1
18. Before I embark upon a task or a problem, I try to find out something about the background.	5	4	3	2	1
19. Mostly, I utilize well the time I have available during the day.	5	4	3	2	1
20. I often have difficulties in finding any meaning in what I have to remember.	5	4	3	2	1
21. I often lie awake worrying about tasks which I think that I cannot handle.	5	4	3	2	1
22. It is important for me to be able to follow an argument or to understand a causal relation.	5	4	3	2	1
23. I like to be told exactly what I should do to learn the subject at hand.	5	4	3	2	1
24. Sometimes I get very eager on certain academic topics and feel that I'd like to continue studying.	5	4	3	2	1

It is very important that you answer **all** the questions: **Please check that you have done this**, before you fill out the consent form on the next page.

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Participation in Grete Seland's PhD project, OAUC

Consent form for the informant

This survey concerns how students choose keywords while they are planning assignment in pedagogy and search for topical information. You will be working for three quarters of an hour at a PC in a computer room with an assignment previously used as an examination task in pedagogy. You are not expected to answer the actual task in the form of a text, but to elaborate the task, selecting appropriate keywords that can be used to structure a good assignment, and which can be used in information searching. All the data collected in this survey will be treaded anonymously. Student informants will receive a voucher of 150 Norwegian crowns for the Penelope bookstore.

Consent form:
I have been informed about the object of this survey. My contribution as a participant includes the questionnaire enclosed with this consent form, and an informant session of three quarters of an hour on May 5th, 6th, or 7th 2009 where I will be using a database of pedagogic terms while I am elaborating an assignment. I consent that the data collected can be used anonymously in Grete Seland's PhD project.

Place/date: ______________________________

Signature: ______________________________

Thank you for spending your time filling in the questionnaire. The filled-in questionnaire should be delivered on arrival at the informant session on May 5th, 6th, or 7th 2009. The survey will take place as the mid-session of the scheduled lectures in pedagogy by Hanne Christensen, Harald Jarning, and Elisabeth Bjørnestad during Week 19 (Tuesday May 5th at 11:30 a.m. to 2:15 p.m., Wednesday May 6th at 08:30 a.m. to 11:15 a.m., and Thursday May 7th at 11:30 a.m. to 2:15 p.m.). The first and last sessions on these dates are reserved for lectures in pedagogy in the regular classroom. The mid-session of the lectures in pedagogy is set aside for this survey, which will take place in the computer room B321 in Pilestredet 52.

Welcome!

Regards from Grete Seland

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Appendix 13 Main session questionnaire of Revealment study

Undersøkelse om bruk av pedagogisk terminologi – Spørreskjema tors. 7. mai 2009

Informasjonen på s. 1 blir gjennomgått muntlig av prosjektleder. **Informant: student301**
Les s. 1 mens du venter. Ikke gå til neste side før du får beskjed. **Fornavn Etternavn**

Program – du får beskjed når det har gått ca. 10 min. og når det er 15 min. igjen av tiden:

Ca. 10 min.	Nøkkelord/momenter til ped-oppgave: organisering av oppgaven og planlegging av søk
Ca. 20 min.	Revisjon av momenter til samme ped-oppgave med bruk av PedNett-basen
Ca. 10 min.	Spørreskjema angående oppgaveskriving og PedNett

• Ikke start på s. 2 før du får beskjed, etter orienteringen fra prosjektleder.
• Jobb kronologisk og gjør deg ferdig med ett spørsmål før du går videre til det neste.
• Les instruksjonene nøye.
• Svar på alle spørsmålene.
• Det er meningen at du skal bruke mesteparten av tiden på jobbingen med PedNett.
• Spør hvis du lurer på noe.

Kort orientering om PedNett-basen
PedNett er laget for å gi studenter starthjelp til å komme i gang med ped-oppgaver ved å gi:
- ideer til pedagogiske fagord som kan brukes i organisering av ped-oppgaver
- tips til aktuelle ord å bruke i søking etter fagstoff

PedNett-basen er på norsk. PedNett er ikke et leksikon eller en ordbok, og er ikke ment å brukes direkte som kilde i oppgaveskriving. Basen er laget på grunnlag av input fra ped-lærere på allmennlærerutdanningen og førskolelærerutdanningen. Lærerne har produsert ordassosiasjoner, dvs. at de har laget assosiative koblinger mellom pedagogiske ord. For hvert par av ord, har de laget en beskrivelse av forholdet mellom de to ordene. Dette er ikke definisjoner, men den enkelte lærers umiddelbare beskrivelse av hvordan to ped-ord har med hverandre å gjøre.

Alle data blir avidentifisert. Deltakerens navn er oppgitt på s. 1 for å koble dette skjemaet til det spørreskjemaet som ble utdelt ved rekrutteringen og levert i forbindelse med dagens hovedundersøkelse. Navnet kobles også til en elektronisk logg over hva deltakeren foretar seg inne i PedNett-basen. Det er kun prosjektleder som har tilgang på personidentifiserbare data (navnelisten og spørreskjemaer med indirekte personopplysninger). Prosjektleder er underlagt taushetsplikt. Opplysningene fra undersøkelsen vil bli behandlet konfidensielt (avidentifisert), og ingen av deltakerne vil kunne kjenne seg igjen i den ferdige doktoravhandlingen. Datamaterialet vil bli anonymisert (deltakerlisten med kobling mellom navn og informantnummer vil bli slettet) når avhandlingen er forsvart i disputas, senest innen utgangen av 2011. Deltagelse i undersøkelsen er frivillig, og samtykke kan trekkes tilbake så lenge studien pågår uten at man må oppgi grunn. Studenter som ikke vil delta i undersøkelsen, har undervisningsfri i det aktuelle tidsrommet. Det vil ikke få innvirkning på studentenes forhold til Høyskolen i Oslo dersom de ikke vil delta i studien eller senere velger å trekke seg. Prosjektet er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS.

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I denne undersøkelsen skal du jobbe med følgende pedagogikk-oppgave, som tidligere har vært gitt til eksamen 2. år ved allmennlærerutdanningen:

Kunnskapsløftet tar opp motivasjon for læring og læringsstrategier (Læreplanverket for Kunnskapsløftet s. 32). Gjør rede for begrepene læring og undervisning. Drøft motivasjonens betydning for læringen.

Bruk BLÅ/SORT penn. Be om penn hvis du ikke har egen.

Har du lest denne oppgaveteksten før? Du kan eventuelt sette flere kryss.

☐ Nei, ny for meg.

☐ Har sett den (i et oppgavesett på Fronter/utdelt i timen). ☐ Har blitt brukt i undervisningen.

☐ Har jobbet med oppgaven på egenhånd og har gjort følgende: ___________________________

____

1. **Sett ring rundt det du mener er hovedtemaene/nøkkelordene i oppgaveteksten.**
   Ett ord pr. ring, og så mange ringer du vil.
   Gå deretter til neste side.

2. **Foreta en usensurert brainstorming over momenter som du mener må være med i besvarelsen.**
   Her skal du bare kjapt få ned på papiret de momentene du kommer på etter å ha lest oppgaveteksten, "hulter til bulter" etter hvert som du kommer på ordene. Det er først i neste punkt du skal jobbe med organisering av ordene. Bruk ca. 2 minutter.

3. **Lag en tabell nedenfor hvor du lar de ordene du ringet inn i oppgaveteksten, være overskrift for hver sin kolonne. Putt momentene fra brainstormingen inn i tabellen (ett eller flere steder). Du kan utelate, føye til eller omformulere ord.**
   Bruk 2-3 minutter.

4. Hvilke temaer (nøkkelord og/eller dine egne momenter) på *det grønne arket* (s. 4) vil du trenge å skaffe mer fagstoff om? Skriv dem ned her, i den rekkefølgen du plukker dem ut:

5. Hvor ville du *startet* med å søke etter fagstoff? Sett *ett* kryss.

☐ Google/Internett. ☐ Bibliotekbase (f.eks. Bibsys). ☐ Annet: ______________________

Eventuell kommentar: ____

____

6. Før opp nøyaktig hva du ville skrevet i søkefeltet: ord og eventuelle tegn.
Tegn opp flere søkebokser hvis du ville gjort flere søk.

Sjekk at du har besvart alle spørsmålene fram til nå før du går videre.

7. Du skal nå gå inn i PedNett og bli kjent med hvordan du beveger deg i basen.

Start Internett.
Gå til følgende nettadresse: http://bibin.hio.no/pednett/
Skriv inn ditt brukernavn: student301
Rekk opp hånden for å få utdelt passord og en rød penn som du skal bruke i fortsettelsen.
Skriv inn passordet og klikk OK. Du står nå på PedNett startside.

Du kan nå prøve ut hvordan du beveger deg rundt i basen ifølge beskrivelsen nedenfor, men ikke gå i gang med å bruke PedNett til å jobbe videre med momenter til ped-oppgaven før du har lest instruksjonene på neste side.

Følgende typer valg er mulige i basen – alt som er blått er klikkbart:

Å gå fra startsiden inn på et av oppslagsordene i den alfabetiske listen.
Å hoppe mellom oppslagsord (dvs. klikke på blå ord når man er inne på en oppslagsside).
Å velge "utvid alle" og "krymp alle" for å få fram/fjerne alle beskrivelser på en oppslagsside.
Å ta "pluss" og "minus" under de blå ordene for å få fram/fjerne beskrivelsen ved ett ord.
Å gå tilbake til startsiden for å velge et nytt ord i den alfabetiske listen.

Les fotnoten nederst på denne siden hvis du lurer på hva pilene betyr.[53]

Gå til neste side i spørreskjemaet for å bruke PedNett-basen i arbeidet med ped-oppgaven.
Spør hvis noe er uklart når det gjelder hvordan du klikker deg rundt i PedNett.

Side 7 av 15

[53] Til noen av de blå ordene i PedNett er det flere beskrivelser, slik man for eksempel ser på oppslagsordet "Lek" når man tar "Utvid alle". Flere piler betyr at flere ped-lærere har laget samme kobling av ordpar. Pil mot høyre betyr at beskrivelsen er laget med utgangspunkt i hvordan oppslagsordet forholder seg til det blå tilknyttede ordet. Pil mot venstre betyr det motsatte.

8. Du skal nå bruke PedNett-basen for å supplere eller revidere momentene som du kom fram til på *det grønne arket* (s. 4) i forbindelse med organisering av oppgaven.

- **Riv løs *det grønne arket* og ha det tilgjengelig foran deg når du går videre.**
- **BRUK RØD PENN til å gjøre tilføyelser og eventuelt overstrykninger på *det grønne arket*, basert på ideer du får mens du bruker PedNett.**
- **Hvis det er ord du leter etter uten å finne i den alfabetiske lista på PedNett startside, fører du dem opp nedenfor tekstboksen du nå leser.**
- **Spør hvis noe er uklart.**

Tidsbruk: Jobb med dette så lenge du ønsker, men ikke lenger enn at du har ca. 15 minutter til rådighet for å gjøre resten av undersøkelsen. Ordinær slutt-tid er kvart over, men du kan forlenge med 10-15 minutter inn i den etterfølgende pausetiden hvis du ønsker det.

Ord du lette etter, men ikke fant i den alfabetiske lista: (Eller fant du alle? ☐ Ja)

Gå videre til neste side når du føler deg ferdig med å revidere momentene på det grønne arket, men senest sånn at du har ca. 15 minutter til rådighet for resten av undersøkelsen.

9. Med utgangspunkt i det du har skrevet med rød penn på det grønne arket (s. 4): Hvilke endringer ønsker du eventuelt å gjøre på *det rosa arket* (s. 5) med temaer som du vil trenge å skaffe mer fagstoff om? Bruk RØD PENN på *det rosa arket*.

10. Hvordan vil du søke nå? Bruk RØD PENN til å gjøre endringer i punkt 6 på *det gule arket* (s. 6). Bruk eventuelt baksiden av *det gule arket* hvis du trenger mer plass.

11. Spørreskjema angående oppgaveskriving og bruk av PedNett: Gå til neste side.

11. Spørreskjema angående oppgaveskriving og bruk av PedNett

Bruk BLÅ/SORT penn.

a) Nedenfor er oppgitt de seks arbeidstrinnene som du jobbet med i forhold til ped-oppgaven du fikk oppgitt i starten av denne undersøkelsen. Sett ring rundt nummeret for de av disse aktivitetene som du *vanligvis* pleier å gjøre når du jobber med en oppgave på studiet (selv om du eventuelt gjør dem på en litt annerledes måte, for eksempel at du ikke gjør alt skriftlig).

1. Avklaring av hva oppgaven spør om: Merker deg det du mener er hovedtemaene/nøkkelordene i oppgaveteksten.
2. Brainstorming: Foretar en brainstorming over momenter som du mener må være med i besvarelsen.
3. Organisering: Ordner dine egne momenter fra brainstormingen i forhold til hovedtemaene/nøkkelordene i oppgaveteksten.
4. Avklaring av hva du kan for lite om: Finner ut hvilke temaer i forrige punkt (nøkkelord og/eller dine egne momenter) som du trenger å skaffe mer fagstoff om.
5. Søking på Internett/bibliotekbase/annet: Bestemmer deg for hvor du vil starte med å søke etter fagstoff.
6. Beslutning om hvordan vil du søke: Finner ut hva du vil skrive i søkefeltet.

b) Hvilke av punktene du har ringet inn over pleier du å gjøre skriftlig? ____________________

c) Bruker du bestemte arbeidsteknikker, for eksempel tankekart? __________________________

d) Pleier du å jobbe i en annen rekkefølge enn i a)? _____________________________________

e) Hva er det neste du normalt vil gjøre: ☐ Søke etter fagstoff. ☐ Lage disposisjon. ☐ Skrive.

☐ Annet: ____

f) Er det andre ting du pleier å gjøre i startfasen av arbeidet med en oppgave på studiet?

____

g) Eventuell utfyllende kommentar om din vanlige arbeidsmåte:

____

h) I denne undersøkelsen jobbet du deg gjennom arbeidstrinnene i a) på forrige side i en ekstra omgang med bruk av PedNett. Opplevde du det som nyttig å jobbe lenger med hvilke ord du vil organisere oppgaven rundt og hvordan du vil søke etter fagstoff? Kunne du tenke deg å sette selve skrivearbeidet "litt på vent" på denne måten ved en senere anledning når du skal lage en oppgavebesvarelse som student? ____

____

____

i) Hva opplever du som de største **utfordringene knyttet til å lage en god besvarelse** på en oppgave i forbindelse med studiet? **Sett kryss på skalaen fra lett til vanskelig** for hvert punkt som er aktuelt for deg nedenfor, for eksempel slik: ←————————X→ Stryk ut punkter som eventuelt beskriver arbeidstrinn du ikke pleier å foreta, og føy eventuelt til egne punkter:

	Lett	**Vanskelig**
Avklare hva oppgaven spør etter (hovedtemaer)	←———	———→
Komme på innfallsvinkler/momenter som kan knyttes til hovedtemaene	←———	———→
Organisere egne momenter i forhold til hverandre og til hovedtemaene..	←———	———→
Avgrense/spisse oppgaven – fokusere – finne mitt perspektiv................	←———	———→
Finne fagstoff utenfor pensum...	←———	———→
Anvende det fagstoffet du skaffer inn i den aktuelle oppgaven	←———	———→
Finne måter å aktualisere/koble teoretiske og praktiske perspektiver	←———	———→
Belyse hvordan pedagogiske begreper kan forstås på flere måter	←———	———→
Koble forskjellige pedagogiske fagord til en ny meningsfull helhet.......	←———	———→
Disponere oppgaven	←———	———→
Drøfte/sette momenter opp mot hverandre i teksten	←———	———→
____________________________________	←———	———→
____________________________________	←———	———→
____________________________________	←———	———→

j) **Sett kryss til venstre for den/de aktuelle punktene i listen over der du mener det vil være nyttig for deg å bruke PedNett til hjelp.**

k) Hva opplever du som de største **utfordringene knyttet spesielt til det å søke etter fagstoff utenfor pensum** i forbindelse med oppgaver på studiet? **Sett kryss på skalaen fra lett til vanskelig** for hvert punkt som er aktuelt for deg nedenfor, for eksempel slik:

←X——————→ Stryk ut punkter som eventuelt beskriver arbeidstrinn du ikke pleier å foreta, og føy eventuelt til egne punkter:

	Lett ←——→ **Vanskelig**
Finne ut hvilke temaer du trenger å skaffe fagstoff om	←——→
Finne ut hvor du vil søke etter fagstoff (Internett/bibliotekbase/annet) ..	←——→
Vurdere kvalitet og finne kvalitetssikret fagstoff når du søker	←——→
Finne ut hvilke ord du vil bruke som søkeord	←——→
Finne ut hvordan du søker på flere ord samtidig	←——→
Komme på nye ord å søke på hvis du ikke får relevante treff	←——→
Finne ut hvordan du kan endre søket hvis du får null treff	←——→
Finne ut hvordan du kan endre søket hvis du får altfor mange treff	←——→
Komme på relaterte faguttrykk som du kan kombinere i søk på ditt tema	←——→
Komme på synonymer/ord med liknende betydning..............................	←——→
Komme på hva et norsk faguttrykk heter på engelsk eller omvendt	←——→
Komme på mer presise/snevrere faguttrykk	←——→
Komme på mer overordnede faguttrykk	←——→
Finne ut hvilke treff som handler om mine temaer på en relevant måte..	←——→
________________________________	←——→
________________________________	←——→
________________________________	←——→

l) **Sett kryss til venstre for den/de aktuelle punktene i listen over der du mener det vil være nyttig for deg å bruke PedNett til hjelp.**

m) Har du fått noen form for opplæring i å søke?

På Internett: ☐ Nei. ☐ Ja. ____

I bibliotekbaser: ☐ Nei. ☐ Ja. ____

n) I punkt 8 på side 8 brukte du PedNett som idébank for å revidere momentene på det grønne arket. Følte du deg ferdig med dette punktet da du gikk videre til punkt 9, eller avbrøt du deg selv for å få nok tid til rådighet for resten av undersøkelsen? ____________________________

____

o) Fikk du noen feilmeldinger mens du jobbet i PedNett?

☐ Nei/ikke så vidt jeg kunne se. ☐ Ja. Eventuell kommentar: __________________________

p) Gjorde du bruk av både de blå ordene og beskrivelsene i sort tekst (de du kunne få fram med ”Utvid alle” eller pluss-tegnet)? Gi en beskrivelse av nytteverdien for deg: _________________

____

____

____

____

____

q) Hvis du brukte beskrivelsene i sort tekst (de du kunne få fram med ”Utvid alle” eller pluss-tegnet) – hva opplevde du eller mener du disse best kan brukes til? Du kan sette flere kryss.

☐ Å finne ut på hvilken måte det blå ordet er knyttet til oppslagsordet øverst på siden.

☐ Å avklare om det blå ordet er aktuelt å ta i bruk i min oppgave.

☐ Å sjekke om beskrivelsen inneholder fagord som er aktuelle for meg å bruke.

☐ Annet: ____

r) Opplevde du det som en fordel når det var flere beskrivelser til et blått ord (slik man for eksempel ser på oppslagsordet ”Lek” når man tar ”Utvid alle”)? ___________________________

____

s) Er det en fordel for deg at de blå ordene som har *flest* beskrivelser kommer øverst på siden, og ordene med kun én beskrivelse kommer nederst? Kommentar: ____________________________

____

t) Eventuelle synspunkter angående PedNett og/eller dagens undersøkelse som ikke har kommet fram i de øvrige punktene: ____

____

____

____

____

____

Nå er du ferdig med undersøkelsen. Hvis du vil bruke PedNett ved en senere anledning, kan du ta med deg side 15. Gå ut av Internett og logg av PCen. Lever skjemaet og det grønne arket, og få med deg et gavekort. Takk for hjelpen!

DETTE ARKET KAN DU RIVE AV OG TA MED DEG HVIS DU ØNSKER DET.
Du må gjerne fortsette å bruke PedNett, som en idébank til pedagogiske fagord i forberedelsen av ped-oppgaver. PedNett er ikke en kvalitetssikret kilde på linje med et leksikon eller en redigert fagbok. Ikke bruk PedNett for å hente definisjoner av begreper eller som kildehenvisning i oppgavebesvarelser, men som en idébank til pedagogiske fagord som kan brukes i organisering av ped-oppgaver og til å forberede søking etter fagstoff. PedNett er laget i forbindelse med denne undersøkelsen, og det foreligger ingen planer om å utvide basen med nye fagord eller beskrivelser.

Nettadresse, brukernavn og passord:

http://bibin.hio.no/pednett/
Brukernavn: student301
Passord: ta med deg lappen du fikk utdelt da du skulle logge deg inn på PedNett.
Skal du logge deg ut av PedNett, avslutter du rett og slett Internett-sesjonen du startet da du gikk inn i basen.

Du ønsker kanskje å jobbe videre med ped-oppgaven du brukte i undersøkelsen?

Kunnskapsløftet tar opp motivasjon for læring og læringsstrategier (Læreplanverket for Kunnskapsløftet s. 32). Gjør rede for begrepene læring og undervisning. Drøft motivasjonens betydning for læringen.

Arbeidstrinnene du jobbet deg gjennom i undersøkelsen var:

1. Avklaring av hva oppgaven spør om: Sett ring rundt det du mener er hovedtemaene/nøkkelordene i oppgaveteksten.
2. Brainstorming: Foreta en usensurert brainstorming over momenter som du mener må være med i besvarelsen.
3. Organisering: Lag en tabell hvor du lar de hovedtemaene/nøkkelordene du ringet inn i oppgaveteksten, være overskrift for hver sin kolonne. Putt momentene fra brainstormingen inn i tabellen (ett eller flere steder).
4. Avklaring av hva du kan for lite om: Finn ut hvilke temaer i forrige punkt (nøkkelord og/eller dine egne momenter) som du trenger å skaffe mer fagstoff om.
5. Søking på Internett/bibliotekbase/annet: Bestem deg for hvor du vil starte med å søke etter fagstoff.
6. Beslutning om hvordan vil du søke: Finn ut hva du vil skrive i søkefeltet.

Takk for at du deltok i undersøkelsen! Vennlig hilsen Grete Seland

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Appendix 14 Translation of main session questionnaire of Revealment study

Survey on students' use of pedagogic terminology – Questionnaire May 7th 2009
The information on page 1 will be presented by the project leader. **Informant: student301**
Please read p.1 while you are waiting. Do not proceed to the next page until you are notified.
First Name Last Name

Program – you will be notified when you have spent 10 minutes, and when you have 15 minutes left:

Approx. 10 min.	Keywords/elements for assignment in pedagogy: organization of the assignment and planning of search
Approx. 20 min.	Revision of elements for the same assignment using the PedNett database
Approx. 10 min.	Questionnaire regarding assignments work and PedNett

- **Please do not start on p. 2 until you are notified, after the briefing from the project leader.**
- **Work in a chronological order and complete one question before moving on to the next.**
- **Please read the instructions carefully.**
- **Answer all the questions.**
- **The intention is that you should spend most of your session time working with PedNett.**
- **Please ask the project leader of you have any questions.**

Short introduction to the PedNett database
PedNett is designed to provide students with a boost for getting started with assignments in pedagogy by providing:
- ideas for pedagogic terminology which can be used in the organization of assignments in pedagogy
- suggestions for relevant words to be used in information searching

The PedNett database is in Norwegian. PedNett is not an encyclopedia or a dictionary, and it is not intended to be used directly as an information source for assignments. The database is made on the basis of input from the teachers in pedagogy at the general and pre-school teacher education programmes. The teachers have produced word associations, i.e. that they have created associative links between pedagogic terms. For each pair of words, they have made a description of the relationship between the two words. These are not definitions, but descriptions of how two pedagogic terms are related, made 'at the spur of the moment' by each individual teacher.

All the data will be de-identified. The participant's name is provided on page one to enable this questionnaire to be connected with the pre-session questionnaire which was distributed in the recruitment process and delivered on arrival at today's informant session. The name will also be connected with an electronic log of the participants' movements in the PedNett database. Only the project manager will have access to personally identifiable data (name list and questionnaires with indirect personal data). The project is subjected to professional secrecy. The data collected in this survey will be treated confidentially (de-identified), and none of the participants will be able to recognize themselves in the PhD thesis. The data will be treated anonymously (the list of participants with the connection between names and informant numbers will be deleted) after the PhD defence, by the end of 2011. The participation in this survey is voluntary, and the consent can be withdrawn as long as the study is ongoing without providing a reason. Students, who do not want to participate in the survey, will not have any lecture at the time of the informant session. It will not affect the students' relationship to Oslo University College if a student does not participate in the study, or if s/he later on chooses to withdraw. The project is reported the Norwegian Social Science Data Services (NSD).

In this session you are going to elaborate on the following assignment in pedagogy, which previously has been used as an examination task for the second year students at the general teacher education:

The Knowledge Promotion reform discusses motivation for learning, and learning strategies (cf. The Knowledge Promotion reform p. 32). Explain the concepts of learning and teaching. Discuss the importance of motivation for learning.

Use a BLUE/BLACK pen. Please request pen if haven't brought your own.

Have you read this assignment text before? You might tick off several boxes.

☐ No, new to me.

☐ Have seen it (in a task set in Fronter/distributed in class). ☐ Has been used in class.

☐ I have worked with the assignment on my own, and have done the following: ____________

____

1. **Please encircle what you think are the main topics/keywords in the assignment text.**
   One word per circle, and as many circles as you want.
   Then go to the next page.

2. **Please make an uncensored brainstorm of which elements you think should be a part of an assignment paper.**
   You are supposed to write down the elements that you can think of after having read the assignment text, 'helter- skelter' as the words come into your mind. It is not until the next step that you will be working with the organization of your words. Use approx. 2 minutes.

3. **Please create a table below in which you use the words that you encircled in the assignment text as headings for the columns. Put the elements of your brainstorm into the table (in one or several columns). You can omit, add, or rephrase words.**
   Use 2-3 minutes.

4. For which topics (keywords and/or your own elements) on the green sheet (p. 4) would you need to obtain more information? Write them down here, in the order that you pick them out:

5. How would you start searching for topical information? Tick off *one* box.

☐ Google/Internet. ☐ Library database (e.g., Bibsys). ☐ Other: ______________________

Any comment: ____

____

6. Write down exactly what you would type in the search field: words, and any signs. Make drawings of more search boxes if you would perform several searches.

Please check that you have answered all the questions on the previous pages before you proceed.

7. **You are now supposed to enter the PedNett database and become familiar with how you can make moves in the database.**

Start Internet.

Go to the following URL: http://bibin.hio.no/pednett/

Enter your username: student301

Raise your hand to be provided with a password and a red pen that you will use when you proceed with your task.

Enter the password and click OK. You are now at the PedNett entry page.

You may now explore how you can make moves in the database according to the description below, but please do not start using PedNett for the elaboration of elements for your assignment before you have read the instructions on the next page.

The following types of moves are available in the database – all the blue elements are clickable:

To go from the entry page into the lookup page for one of the PedNett words in the alphabetical list.
To skip between PedNett words (i.e. clicking the blue words when you are in a lookup page).
To choose ‘expand all’ and ‘collapse all’ to reveal/remove all the descriptions on a lookup page.
To click the ‘plus’ and ‘minus’ signs under the blue words to reveal/remove the description for one word.
To go back to the entry page to choose a new word in the alphabetical list.

Read the footnote at the bottom of this page if you want to know what the arrows indicate.[54]

Proceed to the next page of the questionnaire to use the PedNett database in elaborating your assignment. Please ask if anything is unclear as to how you can click around in the PedNett database.

[54] For some of the blue words in PedNett, there are several descriptions, as you for instance can see in the lookup word ‘Play’ when clicking ‘Expand all’. Several arrows indicate that several teachers in pedagogy have made the same connection of word pairs. A right arrow means that the description is made on the basis of how the lookup word relates to the blue linked word. Left arrow means the opposite.

8. You are now supposed to use the PedNett database to supplement or revise the brainstorm words which you used on *the green sheet* (p. 4) in connection with the organization of your task.

- **Tear off the green sheet and have it available in front of you as you proceed.**
- **USE A RED PEN to make additions and possible deletions on the green sheet, based on ideas generated while you are using PedNett.**
- **If you try to look up a word and realize that it is not to be found in the alphabetical list on the PedNett entry page, please write it down below this textbox.**
- **Please ask if anything is unclear.**

Duration: You can spend as much time as you like on the PedNett part of the task, on the condition that you have approx. 15 minutes at your disposal to make the rest of the session. Ordinary end-time is a quarter past, but you can extend it by 10-15 minutes into the subsequent break if you wish.

Words you were looking for, but did not find in the alphabetical list: (Or did you find all of them? ☐ Yes)

Please proceed to the next page when you consider yourself done in revising the elements at the green sheet, but at the latest so that you have approx. 15 minutes available for the rest of the session.

9. Based on what you have written with red pen on the green sheet (p. 4):
Which changes would you possibly make on the pink paper (p. 5) with topics that you will need to obtain more information about? Use red pen on *the pink sheet*.

10. How would formulate your search now? Use RED PEN to revise section 6 on *the yellow paper* (p. 6). If necessary, use the back of the yellow sheet if you want more space.

11. Questionnaire regarding assignments and the use of PedNett: Please proceed to the next page.

11. Questionnaire regarding assignments and the use of PedNett

Please use the BLUE/BLACK pen.

a) Below you will find a description of the six steps that you elaborated in connection with the assignment in pedagogy which you have been working with in this informant session. Please encircle the number preceding those activities that you usually perform when you elaborate an assignment in association with your studies (even though you might perform them in a slightly different way, for example, that you don't do everything in writing).

1. Clarification of assignment topic: Single out main topics/keywords in the assignment text.
2. Brainstorm: Perform a brainstorm of elements which you think should be a part of the assignment paper.
3. Organization: Organize your elements from the brainstorm in relation to main topics/keywords in the assignment text.
4. Clarification of topics for which you know too little: Find out which topics in the previous paragraph (keywords and/or your own elements) for which you would need to get more topical information.
5. Searching the Internet/a library database/other: Decide in which sources you would like to start searching for topical information.
6. Decision about how you would like to search: Find out what you would write in the search box.

b) Which of the points that you've encircled above do you normally do in writing? ___________

c) Do you use specific working techniques, such as mind maps? __________________________

d) Do you tend to work in a different order than in point a)? ______________________________

e) What is the next thing you would normally do: ☐ Search for topical information. ☐ Make an outline. ☐ Start writing. ☐ Other: ____

f) Are there other things that you usually do in the beginning of the elaboration of assignments which are a part of your studies?

____

g) Any further comments about your normal way of working:

____

h) In this informant session you have elaborated the steps listed in point a) on the previous page twice, the second time in using the PedNett database. Did you find it helpful to work for a longer period of time considering which words you would use in the organization of the assignment, and how you would search for topical information? Would you like to keep the actual writing process 'on hold' in this manner on a later occasion when you have to make an assignment paper as a student? ____

____

____

i) What do you experience as the greatest **challenges associated with making a good assignment** paper associated with your studies? **Put a cross on the scale from 'easy' to 'hard'** for each of the points that are relevant for you, for example: ◄——————X——►
Erase the points which normally do not apply to you, and add any of your own points:

	Easy	**Difficult**
Clarify what the task is all about (main topics)	◄—————►	
Think of perspectives/elements which can be related to the main topics	◄—————►	
Organize your elements in relation to each other and to the main topics	◄—————►	
Refine/focus the assignment – find my own perspective	◄—————►	
Search for topical information outside the curriculum	◄—————►	
Apply the topical information acquired for a specific assignment	◄—————►	
Find ways to update/connect theoretical and practical perspectives …...	◄—————►	
Elucidate how pedagogic concepts can be interpreted in several ways ..	◄—————►	
Connect pedagogic terminology in a new meaningful way	◄—————►	
Make an outline for the assignment	◄—————►	
Discuss different elements in the text with respect to each other	◄—————►	
______________________________	◄—————►	
______________________________	◄—————►	
______________________________	◄—————►	

j) **Put a cross to the left of relevant points in the list above, for which you think it would be helpful for you to use PedNett.**

k) What do you consider to be the greatest **challenges related specifically to the task of searching for topical information outside the curriculum** in relation to assignments on your studies? **Put a cross on the scale from 'easy' to 'hard'** for each of the points that are relevant for you, for example: X

Erase the points which normally do not apply to you, and add any of your own points:

	Easy	Difficult
Figure out for which topics you need to obtain more information		
Figure which sources to use in topical searching (Internet/library/other)		
Quality assessment, finding reliable topical information when searching		
Figure out which words you could use as keywords		
Find out how you can search simultaneously for several words		
Think of alternative terms if you do not get any relevant results		
Find out how you can modify your search if you get zero hits		
Find out how you can modify your search if you get too many hits		
Think of topically related terms which you can combine in your search		
Think of synonyms/words with a similar meaning		
Think of the English equivalent of a Norwegian term, or vice versa ….		
Think of more precise/narrower topical terms		
Think of more general/broader terms		
Find out which of the search results are relevant for my topic………….....		

l) **Put a cross to the left of relevant points in the list above, for which you think it would be helpful for you to use PedNett.**

m) Have you participated in any information searching instruction?

On how to search the Internet:☐ No. ☐ Yes. ___________________________________

On how to search library databases: ☐ No. ☐ Yes. ______________________________

n) In point 8 on page 8, you used PedNett as an idea generator for the revision of your elements on the green sheet. Did you consider yourself done with this point when you proceeded to point 9, or did you have to interrupt yourself to have enough time available for the rest of the sub-tasks of this session? ____

o) Did you get any error messages while you were working in PedNett?

☐ No/Not as far as I could see. ☐ Yes. Comment: ____________________________________

p) Did you use both the blue words and the descriptions in black text (which you could reveal using the 'Expand all' or plus sign)? Give a description of conceived usefulness: ____________

____

____

____

____

____

q) If you used the descriptions in black text (which you could reveal using the 'Expand all' or plus sign) – for what purpose do you think they are best suited? You can tick off several boxes.

☐ To determine how the blue word is related to the lookup word on the top of the page.
☐ To determine whether the blue word is relevant to use in my assignment paper.
☐ To check whether the description contains topical terms which can be relevant for me to use.
☐ Other: ____

r) Did you experience it as an advantage if a blue word was related to several descriptions (as you can see in the lookup word ‘Play’ when clicking ‘Expand all’)? ______________________________

____

s) Do you find it advantageous that the blue words with the most descriptions are listed at the top of the page, and that the words with only one description each are listed at the bottom?
Comment: ____

t) Do you have any other opinions regarding PedNett and/or this informant session which you have not presented in the previous points: ____

____

____

____

____

____

You have now completed the informant session. If you want to use PedNett on a later occasion, you can take with you the last sheet (p. 15). Please exit Internet and log off the PC. Please deliver this questionnaire and the green sheet, and catch a voucher when you leave. Thanks for your help!

YOU MAY TEAR OFF THIS SHEET AND TAKE IT WITH YOU IF YOU WANT TO.
You are welcome to continue using PedNett, as an idea generator for pedagogic terminology in your elaboration of assignments on your study. PedNett is not a quality assured source in line with an encyclopedia or an edited textbook. Please do not use PedNett to retrieve definitions of concepts or as a source of reference in assignment papers, but as an idea generator for pedagogic terminology which can be used in the organization of assignments in pedagogy and preparations for topical information searching. PedNett is made in connection with this survey, and there are no plans to extend the database further with new topical terms or descriptions.

URL, username and password:

http://bibin.hio.no/pednett/
Username: student301
Password: take with you the tag you were provided with during the session, before entering PedNett.
When you want to log out of PedNett, you simply quit the Internet session you started when you entered the database.

Maybe you would like to elaborate further the assignment in pedagogy used in this session?

The Knowledge Promotion reform discusses motivation for learning, and learning strategies (cf. The Knowledge Promotion reform p. 32). Explain the concepts of learning and teaching. Discuss the importance of motivation for learning.

The six steps that you have elaborated in this session were:

1. Clarification of assignment topic: Single out main topics/keywords in the assignment text.
2. Brainstorm: Perform a brainstorm of elements which you think should be a part of the assignment paper.
3. Organization: Organize your elements from the brainstorm in relation to main topics/keywords in the assignment text.
4. Clarification of topics for which you know too little: Find out which topics in the previous paragraph (keywords and/or your own elements) for which you would need to get more topical information.
5. Searching the Internet/a library database/other: Decide in which sources you would like to start searching for topical information.
6. Decision about how you would like to search: Find out what you would write in the search box.

Thank you for your participation in this survey! Sincerely Grete Seland

Appendix 15 Simulated work tasks

Task A

Gjør rede for enhetsskolebegrepet og vurder hvordan dette står i sammenheng med begrepene likhet, likeverd og inkludering. Drøft hvordan du som lærer vil legge til rette for en inkluderende opplæring i en flerkulturell skole.

Task B

Kunnskapsløftet tar opp motivasjon for læring og læringsstrategier (Læreplanverket for Kunnskapsløftet s. 32). Gjør rede for begrepene læring og undervisning. Drøft motivasjonens betydning for læringen.

Translation: Cf. Appendix 16.

Appendix 16 Translated simulated work tasks

Task A

Work task facets:

Enhetsskole	Comprehensive school
Likhet	Likeness
Likeverd	Equality
Inkludering	Inclusion
Inkluderende opplæring	Inclusive education
Flerkulturell skole	Multicultural school

Work task: Explain the concept of the *comprehensive school* and consider how this concept is connected with the concepts of likeness, equality, and inclusion. Discuss how you as a teacher will facilitate an inclusive education in a multicultural school.

Task B

Work task facets:

Kunnskapsløftet	The Knowledge Promotion reform
Motivasjon	Motivation
Læring	Learning
Læringsstrategier	Learning strategies
Undervisning	Teaching

Work task: The Knowledge Promotion reform discusses motivation for learning, and learning strategies (cf. The Knowledge Promotion reform p. 32). Explain the concepts of learning and teaching. Discuss the importance of motivation for learning.

Appendix 17 Log of actions performed in PedNett during informant session

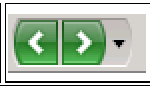
Logg for Bruker student302 2009-05-07 12:53:39 – 2009-05-07 13:14:40

Tid	Startsiden	inni ordnode	Tilbakeknapp	Til ordnode	Utvid alle	Krymp alle	Utvid ett ord	Krymp ett ord	Til startside
2009-05-07 12:53:39				Motivasjon					
2009-05-07 12:54:42		Motivasjon		Mestring					
2009-05-07 12:55:01		Mestring		Motivasjon					
2009-05-07 12:55:03		Motivasjon		Attribusjon					
2009-05-07 12:55:06		Attribusjon		Motivasjon					
2009-05-07		Motivasjon		Attribusjonsteorier					

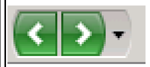
12:55:0 7									
2009-05-07 12:55:1 3		Attribusjonsteorie r							x
2009-05-07 12:55:3 4	x			Læring					
2009-05-07 12:56:2 1		Læring							x
2009-05-07 12:56:3 0	x			Piaget					
2009-05-07 12:56:3 2		Piaget							x
2009-05-07 12:56:4 4	x			Hargreaves					
2009-05-07 12:56:4 6		Hargreaves							x

2009-05-07 12:57:03	x			Undervisning					
2009-05-07 12:57:39		Undervisning							x
2009-05-07 12:57:48	x			Sigøynere					
2009-05-07 12:57:49		Sigøynere							x
2009-05-07 12:57:57	x			Vygotskij					
2009-05-07 12:57:59		Vygotskij							x
2009-05-07 12:58:10	x			Tilpasset opplæring (TPO)					
2009-05-07		Tilpasset opplæring (TPO)							x

12:58:15									
2009-05-07 12:58:28	x			Læreplanverket for Kunnskapsløftet (LK06)					
2009-05-07 12:58:42		Læreplanverket for Kunnskapsløftet (LK06)							x
2009-05-07 12:58:47	x			Læreplanverket for Kunnskapsløftet (LK06)					
2009-05-07 12:58:48		Læreplanverket for Kunnskapsløftet (LK06)		Kompetansemål					
2009-05-07 12:58:49		Kompetansemål		Læreplanverket for Kunnskapsløftet (LK06)					
2009-05-07 12:58:50		Læreplanverket for Kunnskapsløftet (LK06)		Kompetansemål					
2009-05-07 12:58:51		Kompetansemål		Læreplanverket for Kunnskapsløftet (LK06)					

2009-05-07 12:58:52		Læreplanverket for Kunnskapsløftet (LK06)		Didaktikk					
2009-05-07 12:58:54		Didaktikk					Den didaktiske relasjonsmodellen		
2009-05-07 12:58:57				Didaktikk					
2009-05-07 12:59:08		Didaktikk						Den didaktiske relasjonsmodellen	
2009-05-07 12:59:11									x
2009-05-07 12:59:20	x			Didaktikk					
2009-05-07 12:59:24		Didaktikk					Den didaktiske relasjonsmodellen		
2009-05-07				Didaktikk					

12:59:26									
2009-05-07 12:59:28		Didaktikk							x
2009-05-07 12:59:37	x			Mestring					
2009-05-07 12:59:42		Mestring							x
2009-05-07 12:59:50	x			Måloppnåelse					
2009-05-07 12:59:53		Måloppnåelse					Mestring		
2009-05-07 12:59:57									x
2009-05-07 13:00:28	x			Sosialisering					

2009-05-07 13:00:33		Sosialisering							x
2009-05-07 13:01:04	x			Vurdering					
2009-05-07 13:01:06		Vurdering					Evaluering		
2009-05-07 13:01:10								Evaluering	
2009-05-07 13:04:50									x
2009-05-07 13:05:14	x			Sigøynere					
2009-05-07 13:05:15		Sigøynere					Etniske minoriteter		
2009-05-07									x

13:05:24									
2009-05-07 13:10:47	x			Nordahl					
2009-05-07 13:10:49		Nordahl					Relasjonskompetanse		
2009-05-07 13:10:53								Relasjonskompetanse	
2009-05-07 13:10:54							Selvoppfatning		
2009-05-07 13:10:56								Selvoppfatning	
2009-05-07 13:10:57									x
2009-05-07 13:11:06	x			Metakognitive læringsstrategier					

2009-05-07 13:11:07		Metakognitive læringsstrategier					Læringsstrategier		
2009-05-07 13:11:10						x			
2009-05-07 13:11:12									x
2009-05-07 13:11:20	x			Læringsplakaten					
2009-05-07 13:11:21		Læringsplakaten					Læreplanverket for Kunnskapsløftet (LK06)		
2009-05-07 13:11:28								Læreplanverket for kunnskapsløftet (LK06)	
2009-05-07 13:11:29							Læreplanverket for Kunnskapsløftet (LK06)		
2009-05-07								Læreplanverket for Kunnskapsløftet	

13:11:32								(LK06)	
2009-05-07 13:11:33							Broen		
2009-05-07 13:11:36								Broen	
2009-05-07 13:11:37							Generelle prinsipper		
2009-05-07 13:11:38								Generelle prinsipper	
2009-05-07 13:11:39									x
2009-05-07 13:11:53	x			Vurdering					
2009-05-07 13:11:54		Vurdering					Karakterer		

2009-05-07 13:12:12								Karakterer	
2009-05-07 13:12:13							Evaluering		
2009-05-07 13:12:16								Evaluering	
2009-05-07 13:12:17							Tilbakemeldinger		
2009-05-07 13:12:22								Tilbakemeldinger	
2009-05-07 13:12:24							Kritikk		
2009-05-07 13:12:28								Kritikk	
2009-05-07							Kvalitet		

13:12:30									
2009-05-07 13:12:33								Kvalitet	
2009-05-07 13:12:37							Uformell vurdering		
2009-05-07 13:12:47								Uformell vurdering	
2009-05-07 13:12:50									x
2009-05-07 13:14:22	x			Bruner					
2009-05-07 13:14:24		Bruner					Sonen for nærmeste utvikling		
2009-05-07 13:14:26									x

2009-05-07 13:14:33	x			Ansvar for egen læring					
2009-05-07 13:14:34		Ansvar for egen læring					Elevforutsetninger		
2009-05-07 13:14:40									x

Appendix 18 The 8 terminological steps by one informant: main questionnaire

In this appendix: Filled-in form of pp. 2-6 of main questionnaire by an *Enricher* informant.
In appendix 19: Registration in the empirical database of the same data.[55]

I denne undersøkelsen skal du jobbe med følgende pedagogikk-oppgave, som tidligere har vært gitt til eksamen 2. år ved allmennlærerutdanningen:

> Kunnskapsløftet tar opp motivasjon for læring og læringsstrategier (Læreplanverket for Kunnskapsløftet s. 32). Gjør rede for begrepene læring og undervisning. Drøft motivasjonens betydning for læringen.

Bruk BLÅ/SORT penn. Be om penn hvis du ikke har egen.

Har du lest denne oppgaveteksten før? Du kan eventuelt sette flere kryss.

☒ Nei, ny for meg.

☐ Har sett den (i et oppgavesett på Fronter/utdelt i timen). ☐ Har blitt brukt i undervisningen.

☐ Har jobbet med oppgaven på egenhånd og har gjort følgende: ______________________

____

1. **Sett ring rundt det du mener er hovedtemaene/nøkkelordene i oppgaveteksten.**
   Ett ord pr. ring, og så mange ringer du vil.
   Gå deretter til neste side.

Informant: - Prosjektleder: Grete Seland, grete.seland@jbi.hio.no **Side 2 av 15**

[55] In appendices 18-19 I use data from another informant than the *Enricher* informant described in section 4.6.4.

2. **Foreta en usensurert brainstorming over momenter som du mener må være med i besvarelsen.**
Her skal du bare kjapt få ned på papiret de momentene du kommer på etter å ha lest oppgaveteksten, "hulter til bulter" etter hvert som du kommer på ordene. Det er først i neste punkt du skal jobbe med organisering av ordene. Bruk ca. 2 minutter.

- LK06
- ulike former for undervisning som fremmer læring.
- motivasjon for å lære
- motivasjon for å lære lort.
- variert undervisning
- IOP

DENNE SIDEN VAR
TRYKKET PÅ GRØNT ARK

3. **Lag en tabell nedenfor hvor du lar de ordene du ringet inn i oppgaveteksten, være overskrift for hver sin kolonne. Putt momentene fra brainstormingen inn i tabellen (ett eller flere steder). Du kan utelate, føye til eller omformulere ord.**

   Bruk 2-3 minutter.

læringsstrategier	læring/læringsutbytte	undervisning	motivasjon
• IOP	• LK06	• LK06	• for å lære
• LK06	• IOP	• variert	• for å lære bort
• Arbeidsmåter	• vurdering av læringen	• IOP	• mestring
• Elev-forutsetninger	• læringsresultater	• klasseledelse	• belønning
• Metakognitive læringsstrategier	• mål oppnåelse	• den proksimale utviklingssone	• Indre og ytre motivasjon
• Selvregulert læring	• ulike former for læring:	• arbeidsformer	• Interesser
	• lek	• fagdidaktikk	• stimuli
	• mestring	• læringssituasjoner	• sosial mestring
	• sosialisering	• Pedagogikk	
	• fag		
	• lære forutsetninger		

TILFØYELSER I RØDT

ROSA ARK.

4. Hvilke temaer (nøkkelord og/eller dine egne momenter) på *det grønne arket* (s. 4) vil du trenge å skaffe mer fagstoff om? Skriv dem ned her, i den rekkefølgen du plukker dem ut:

- Læringsstrategier
- Motivasjon
- Læring
- undervisning
- IOP /LK06

Vil ikke endret noe, men kanskje fort IOP/LK06 lengre opp på listen, men stod mye bra om dette også.

TILFØYELSER I RØDT

Informant · Prosjektleder: Grete Seland, grete.seland@jbi.hio.no **Side 5 av 15**

GULT ARK

5. Hvor ville du *startet* med å søke etter fagstoff? Sett *ett* kryss.

☐ Google/Internett. ☐ Bibliotekbase (f.eks. Bibsys). ☒ Annet: Fagbøker

Eventuell kommentar: ______________________

____

6. Før opp nøyaktig hva du ville skrevet i søkefeltet: ord og eventuelle tegn.
Tegn opp flere søkebokser hvis du ville gjort flere søk.

"læringsstrategier i skolen"

"strategier i skolen"

TILFØYELSER I RØDT

Vet ikke om jeg ville endret søkeordene mine men kanskje forkorte til bare (har bare gått ut fra det ene ordet.

"læringsstrategier"

Appendix 19 The 8 terminological steps by one informant: empirical database

This appendix shows the registration by an *Enricher* informant in the empirical database of the data which was provided in the filled-in form of pp. 2-6 of the main questionnaire, as cited in appendix 18.[56]

Informant_no	304
Step_no_1	Læringsstrategier Læring Undervisning Motivasjon
Step_no_1_N_mainwords	4
Step_no_1_analysis	-
Step_no_2	LK06 Ulike former for undervisning som fremmer læring Motivasjon for å lære Motivasjon for å lære bort Variert undervisning IOP
Step_no_2_N_lines	6
Step_no_2_analysis	-
Step_no_3	Læringsstrategier: IOP, LK06 Læring: LK06, IOP, Vurdering av læringen Undervisning: LK06, variert, IOP Motivasjon: for å lære, for å lære bort
Step_no_3_N_column	4
Step_no_3_N_bluewords_incl_dupl	10
Step_no_3_N_unique_bluewords	6
Step_no_3_analysis	-
Step_no_4	Læringsstrategier Motivasjon Læring Undervisning IOP/LK06
Step_no_4_N_bluetopics	5

[56] In appendices 18-19 I use data from another informant than the *Enricher* informant described in section 4.6.4.

Step_no_4_analysis	-
Step_no_5	"Læringsstrategier i skolen" "strategier i skolen"
Step_no_5_N_bluewords_incl_dupl	4
Step_no_5_N_unique_bluewords	3
Step_no_5_N_bluesearchboxes	2
Step_no_5_analysis	-
Step_no_6_in_context	[Læringsstrategier] arbeidsmåter, elevforutsetninger, metakognitive læringsstrategier, selvregulert læring [Læring] læringsutbytte, læringsresultater, måloppnåelse, ulike former for læring, lek, mestring, sosialisering, fag, læreforutsetninger [Undervisning] klasseledelse, den proksimale utviklingssone, arbeidsformer, fagdidaktikk, læringssituasjoner, pedagogikk [Motivasjon] mestring, belønning, indre og ytre motivasjon, interesser, stimuli, sosial mestring
Step_no_6_unique_redwords	Arbeidsmåter Elevforutsetninger Metakognitive læringsstrategier Selvregulert læring Læringsutbytte Læringsresultater Måloppnåelse Ulike former for læring Lek Mestring Sosialisering Fag Læreforutsetninger Klasseledelse Den proksimale utviklingssone Arbeidsformer Fagdidaktikk Læringssituasjoner Pedagogikk Mestring Belønning Indre og ytre motivasjon Interesser Stimuli Sosial mestring
Step_no_6_first_occurr	Arbeidsmåter Elevforutsetninger Metakognitive læringsstrategier

	Selvregulert læring Læringsutbytte Læringsresultater Måloppnåelse Ulike former for læring Lek Mestring Sosialisering Fag Læreforutsetninger Klasseledelse Den proksimale utviklingssone Arbeidsformer Fagdidaktikk Læringssituasjoner Pedagogikk Mestring Belønning Indre og ytre motivasjon Interesser Stimuli Sosial mestring
Step_no_6_N_first_occurr	25
Step_no_6_N_unique_redwords	25
Step_no_6_N_unique_remo_bluewords	0
Step_no_6_N_unique_blueredwords	31
Step_no_6_analysis	Uvanlig høyt antall nye termer hentet fra PedNett.
Step_no_7_in_context	Vil ikke endret noe, men kanskje ført IOP/LK06 lengre opp på listen, men sto mye bra om dette også.
Step_no_7_unique_redtopics	-
Step_no_7_first_occurr	-
Step_no_7_N_first_occurr	0
Step_no_7_N_unique_redtopics	0
Step_no_7_N_unique_remo_bluetopics	0
Step_no_7_N_unique_blueredtopics	5
Step_no_7_analysis	Ingen endring i antall/innhold på temaer.
Step_no_8_in_context	Vet ikke om jeg ville endret søkeordene mine, men kanskje forkorte til bare: Læringsstrategier Har bare gått ut fra det ene ordet.
Step_no_8_unique_redwords	-
Step_no_8_first_occurr	-
Step_no_8_N_first_occurr	0
Step_no_8_N_unique_redwords	0
Step_no_8_N_unique_remo_bluewords	2
Step_no_8_N_unique_blueredwords	1

Step_no_8_N_redsearchboxes	1
Step_no_8_N_remo_bluesearchboxes	2
Step_no_8_N_total_blueredboxes	1
Step_no_8_analysis	Føyer til 25 nye ord fra PedNett på grønt ark step 6, men søkestrategien avgrenses ned til ett søkeord: Læringsstrategier. Fokusering/presisering.
Words_missing_Y/N	j
Words_missing_list	-
Analysis_general	Anchoring effect – tar inn 25 PedNett-termer i step 6, men gjør få/ingen endringer i step 8.

Appendix 20 Empirical database tables and fields

The data registered by the student informants in the pre-session and main session questionnaires in the Revealment study was entered into an SQL database made for this purpose, referred to as the empirical database (cf. section 3.4.3.1). This appendix provides an overview of the tables contained in the database, presented with field names and examples of what kind of data was registered in each field. The nine tables were provided with the following names:

0_analysis_all_informants
1_informants
2_info_behaviour
3_assist
4_before_pednett_use
5_terminological_steps
6_after_pednett_use
_category_values
_field_names

Table name: 0_analysis_all_informants	
Table contents:	
Field name	*Example of filled-in field*
Tema	Ferdig med PedNett eller avbrøt seg selv?
Filed_name1	Finished_or_interrupted
Filed_name2	Finished_interpreted
Results_and_analysis	Ferdig 30, avbrøt 23, uavklart 1 = 54 total
Follow_up	Kommentere i metodekapitlet at spørsmål 11n) s. 13 var uheldig formulert (fordi jeg spør om to ting samtidig) - så et ja/nei-svar blir uavklart. Ja til at man var ferdig, eller at man avbrøt seg selv?

Table name: 1_informants	
Table contents:	
Field name	*Example of filled-in field*
Informant_no	101
Age	23
Gender	k
First_language	Norsk
Ped_studies_Y/N	j
Ped_studies_specification	Universitetet i Oslo, UTVIT1000

Table name: 2_info_behaviour	
Table contents:	
Field name	*Example of filled-in field*
Informant_no	101

Internet/Google_experience	4-6å
Google_frequency	d
Libr_cat_frequency	0
Article_datab_frequency	0
Term_challenge	c2
Term_challenge_comment	-
Rephrase_challenge	c2
Rephrase_challenge_comment	-
Main_challenge	Få frem dokumenter som er troverdige, og kan brukes som sikre kilder.
Info_source_01	1
Info_source_02	1
Info_source_03	1
Info_source_04	1
Info_source_05	0
Info_source_06	0
Info_source_07	1
Info_source_08	0
Info_source_09	0
Info_source_10	0
Info_source_11	0
Info_source_12	0
Info_source_12_comment	-
Criterion_precision	Feil_total_95
Criterion_recall	Feil_total_50

Table name: 3_assist	
Table contents:	
Field name	*Example of filled-in field*
Informant_no	101
Total	72
Deep	29
Surface	17
Strategic	26
A01	4
A02	4
A03	4
A04	5
A05	4
A06	4
A07	2
A08	5
A09	2

A10	4
A11	4
A12	2
A13	2
A14	4
A15	2
A16	2
A17	1
A18	4
A19	2
A20	1
A21	1
A22	4
A23	4
A24	1

Table name: 4_before_pednett_use	
Table contents:	
Field name	*Example of filled-in field*
Informant_no	101
Seen_before_Y/N	n
Seen_before_fronter	0
Seen_before_in_class	0
Seen_before_worked_on	0
Seen_before_comment	-
Searching_start_Google	1
Searching_start_library_base	0
Searching_start_other	0
Searching_start_other_comment	-
Searching_comment	-
Analysis_general	-

Table name: 5_terminological_steps	
Table contents:	
Field name	*Example of filled-in field*
Informant_no	101
Step_no_1	Rede for Enhetsskolebegrepet Vurder Sammenheng Likhet Likeverd Inkludering Drøft

	Lærer Inkluderende opplæring Flerkulturell skole
Step_no_1_N_mainwords	11
Step_no_1_analysis	-
Step_no_2	Definisjon enhetsskolebegrepet Historikk før og etter 1920 Skille begrepene likhet, likeverd og inkludering Hvordan stiller enhetsskolen seg ift. dette? Inkluderende opplæring - alle bli sett, føle tilhørighet - bli kjent med kulturer i klasserommet, evt. religion – toleranse - annerledes er ikke rart Likeverd Inkludering så langt det er mulig Målet med enhetsskolen Segregerte vs. integrerte løsninger
Step_no_2_N_lines	12
Step_no_2_analysis	-
Step_no_3	Rede for: definisjon Enhetsskolebegrepet: definisjon, historikk Vurder: skille begrepene, målet med enhetsskole Sammenheng: sammenligne begrepene Likhet: segregerte vs. integrerte Likeverd: segregerte vs. integrerte Inkludering: segregerte vs. integrerte Drøft: annerledes er ikke rart Lærer: annerledes er ikke rart, ansvar for å utvikle holdninger Inkluderende opplæring: alle bli sett, føle tilhørighet, så langt det er mulig Flerkulturell skole: alle bli sett, føle tilhørighet, bli kjent med ulike kulturer/religioner, toleranse
Step_no_3_N_column	11
Step_no_3_N_bluewords_incl_dupl	22
Step_no_3_N_unique_bluewords	13
Step_no_3_analysis	-
Step_no_4	Definisjoner/forståelse av begrepene likhet,

	likeverd, (inkludering) Dette er begreper som henger nært sammen, men som likevel har ulik betydning Hvordan bli sett? Føle tilhørighet? Flere momenter enn de jeg kan tenke meg ... Definisjon enhetsskolebegrepet Historikk på noen områder innen enhetsskolens utvikling
Step_no_4_N_bluetopics	5
Step_no_4_analysis	-
Step_no_5	www.google.com www.wikipedia.no/com
Step_no_5_N_bluewords_incl_dupl	0
Step_no_5_N_unique_bluewords	0
Step_no_5_N_bluesearchboxes	0
Step_no_5_analysis	-
Step_no_6_in_context	[Vurder: skille begrepene] <ringet inn og tilføyd utropstegn> [Sammenheng: sammenligne begrepene] se spesielt på sammenhenger/forskjeller på likhet/likeverd, viktig å skille dem fra hverandre! [Flerkulturell skole: bli kjent med ulike kulturer/religioner, toleranse] føre til mobbing
Step_no_6_unique_redwords	Mobbing
Step_no_6_first_occurr	Mobbing
Step_no_6_N_first_occurr	1
Step_no_6_N_unique_redwords	1
Step_no_6_N_unique_remo_bluewords	0
Step_no_6_N_unique_blueredwords	14
Step_no_6_analysis	Kommentar: Informanten føyer til kun ett ord fra PedNett: mobbing. Ellers prosessuelle kommentarer om hvordan hun vil behandle sine egne momenter.
Step_no_7_in_context	[Likhet, likeverd] skille mellom disse [Føle tilhørighet] hva vil det si? [Definisjon enhetsskolebegrepet] finne dette et sted Toleranse – kan føre til mobbing. Spesielt viktig å opparbeide i et flerkulturelt klasserom.
Step_no_7_unique_redtopics	Toleranse Flerkulturelt klasserom

Step_no_7_first_occurr	Flerkulturelt klasserom
Step_no_7_N_first_occurr	1
Step_no_7_N_unique_redtopics	1
Step_no_7_N_unique_remo_bluetopics	0
Step_no_7_N_unique_blueredtopics	6
Step_no_7_analysis	Kommentar: Informanten føyer til kun ett nytt ord, og det finnes ikke i PedNett: flerkulturelt klasserom. Ellers prosessuelle kommentarer om hvordan hun vil behandle sine egne momenter.
Step_no_8_in_context	Søke mer spesifikt på begreper. Hovedbegreper, og finne andre begreper innen samme kategori under dette hvis mulig.
Step_no_8_unique_redwords	-
Step_no_8_first_occurr	-
Step_no_8_N_first_occurr	0
Step_no_8_N_unique_redwords	0
Step_no_8_N_unique_remo_bluewords	0
Step_no_8_N_unique_blueredwords	0
Step_no_8_N_redsearchboxes	0
Step_no_8_N_remo_bluesearchboxes	0
Step_no_8_N_total_blueredboxes	0
Step_no_8_analysis	I step5 oppgis ikke søketermer, men URLer til google og wikipedia. I step8 oppgis heller ikke søketermer, men søkestrategi.
Words_missing_Y/N	n
Words_missing_list	Segregert Tilhørighet
Analysis_general	-

Table name: 6_after_pednett_use	
Table contents:	
Field name	*Example of filled-in field*
Informant_no	101
Working_steps_1	1
Working_steps_2	1
Working_steps_3	1
Working_steps_4	0
Working_steps_5	1
Working_steps_6	0
Working_steps_1_written	1
Working_steps_2_written	1
Working_steps_3_written	1
Working_steps_4_written	0
Working_steps_5_written	0
Working_steps_6_written	0

Working_steps_1_6_written_comment	Av og til på PC også.
Working_techniques	Tankekart (mer på større områder). Tankekart fører til at jeg setter opp viktige begreper med "underbegreper" ned fra hovedbegrepet.
Different_working_order_Y/N	n
Different_working_order_Y/N_comment	Nei, men alternativ 6 er ikke så ofte med ...
Next_step_searching	1
Next_step_disposition	1
Next_step_writing	0
Next_step_other	0
Next_step_other_comment	-
Other_initial_steps	Nei, starter med å forstå hva oppgaven ber meg om å svare på, og videre bestemme meg for hvordan jeg på best mulig måte kan gjøre det.
Working_procecure_comment	-
Usefulness_six_steps	Ja.
Work_task_challenge_1	l
Work_task_challenge_1_Pedhelp	0
Work_task_challenge_2	m
Work_task_challenge_2_Pedhelp	1
Work_task_challenge_3	v
Work_task_challenge_3_Pedhelp	1
Work_task_challenge_4	v
Work_task_challenge_4_Pedhelp	0
Work_task_challenge_5	l
Work_task_challenge_5_Pedhelp	1
Work_task_challenge_6	l
Work_task_challenge_6_Pedhelp	1
Work_task_challenge_7	v
Work_task_challenge_7_Pedhelp	0
Work_task_challenge_8	v
Work_task_challenge_8_Pedhelp	1
Work_task_challenge_9	m
Work_task_challenge_9_Pedhelp	1
Work_task_challenge_10	m
Work_task_challenge_10_Pedhelp	0
Work_task_challenge_11	m
Work_task_challenge_11_Pedhelp	0
Work_task_challenge_12_Added_point_1	-
Work_task_challenge_12	-
Work_task_challenge_12_Pedhelp	0
Work_task_challenge_13_Added_point_2	-
Work_task_challenge_13	-
Work_task_challenge_13_Pedhelp	0
Work_task_challenge_14_Added_point_3	-

Work_task_challenge_14	-
Work_task_challenge_14_Pedhelp	0
Work_task_challenge_diff1	7
Work_task_challenge_diff2	4
Work_task_challenge_diff3	3
Work_task_challenge_easy1	5
Work_task_challenge_easy2	1
Work_task_challenge_easy3	6
Search_task_challenge_1	l
Search_task_challenge_1_Pedhelp	0
Search_task_challenge_2	l
Search_task_challenge_2_Pedhelp	0
Search_task_challenge_3	l
Search_task_challenge_3_Pedhelp	1
Search_task_challenge_4	m
Search_task_challenge_4_Pedhelp	1
Search_task_challenge_5	m
Search_task_challenge_5_Pedhelp	0
Search_task_challenge_6	m
Search_task_challenge_6_Pedhelp	1
Search_task_challenge_7	l
Search_task_challenge_7_Pedhelp	1
Search_task_challenge_8	v
Search_task_challenge_8_Pedhelp	0
Search_task_challenge_9	m
Search_task_challenge_9_Pedhelp	1
Search_task_challenge_10	l
Search_task_challenge_10_Pedhelp	0
Search_task_challenge_11	m
Search_task_challenge_11_Pedhelp	0
Search_task_challenge_12	m
Search_task_challenge_12_Pedhelp	1
Search_task_challenge_13	l
Search_task_challenge_13_Pedhelp	1
Search_task_challenge_14	m
Search_task_challenge_14_Pedhelp	0
Search_task_challenge_15_Added_point_1	-
Search_task_challenge_15	-
Search_task_challenge_15_Pedhelp	0
Search_task_challenge_16_Added_point_2	-
Search_task_challenge_16	-
Search_task_challenge_16_Pedhelp	0
Search_task_challenge_17_Added_point_3	-
Search_task_challenge_17	-
Search_task_challenge_17_Pedhelp	0

Search_task_challenge_diff1	8
Search_task_challenge_diff2	11
Search_task_challenge_diff3	0
Search_task_challenge_easy1	2
Search_task_challenge_easy2	1
Search_task_challenge_easy3	10
Search_training_Internett_Y/N	j
Search_training_Internett_Y/N_comment	I datatimene på ungdomsskolen.
Search_training_library_Y/N	j
Search_training_library_Y/N_comment	Nja, en liten innføring ved starten på HiO.
Finished_interpreted	ferdig
Finished_or_interrupted	Kunne hatt litt bedre tid, men fikk med det jeg følte var viktigst.
Error_messages_Y/N	n
Error_messages_Y/N_comment	-
Usefulness_blue_black	Fint med begreper med "svar", i tillegg til at du får opp andre ord/begreper som kan være nyttig ift. det ordet jeg opprinnelig ville klikke på. Virket utfyllende for det opprinngelige ordet. Jeg gjorde meg nytte av det.
Black_text_applications_1	1
Black_text_applications_2	0
Black_text_applications_3	1
Black_text_applications_4	0
Black_text_applications_4_comment	-
Advantage_several_descr_Y/N	j
Advantage_several_descr_Y/N_comment	Ja, absolutt!
Advantage_frequency_Y/N	j
Advantage_frequency_Y/N_comment	Ja, det synes jeg.
Final_comment	Det var et bra system, med mange nyttige begreper. Kjempefint med de ekstra begrepene som kunne knyttes opp mot det opprinnelige. Dette gjør det lettere for meg som eventuelt skal skrive oppgave å få inspirasjon til flere momenter som kan være nyttig å ha med.
PedNett_use_afterwards_Y/N	n
PedNett_use_afterwards_Y/N_comment	-
Analysis_general	-

Table name: _category_values	
Table contents:	
Field	*Example of filled-in field*
Category	Gender
Value	k
Specification	Kvinne

Table name: _field_names	
Table contents:	
Field	*Example of filled-in field*
Field_name	Informant_no
Table_name	2_Info_behaviour
Questionnaire_no	1:1
Question	[Informantnummer tildelt av prosjektleder.]
Category	[Tresifret tall]

Appendix 21 Informant overview

The table indicates PedNett user type, learning style, formulation behaviour, previous studies in pedagogy and prior knowledge of the assigned work task

Informant	*PedNett user type: Enricher (7), Reactivator (6), Applicator (32), Combiner (6), Aloofer (2), Rejecter (1)*	*Deep*	*Surface*	*Strategic*	*Total score learning style*	*Facet-embracing (F-e), 14 inf.*	*Phrasing (Ph), 6 inf.*	*Facet-trusting (F-t), 45 inf.*	*Self-production (S-p), 31 inf.*	*First-patching (Ta), 10 inf.*	*Narrowing (Na), 8 inf.*	*Fastening (Fa), 9 inf.*	*Final-patching (Fo), 5 inf.*	*Removing (Re), 11 inf.*	*Adjusting (Ad), 3 inf.*	*Previous studies in pedagogy*	*Previous knowl. worktask*
101	Alo	29	17	26	72	F-e	Ph	F-t (14)								j Universitetet i Oslo, UTVIT1000	n
102	App	34	19	26	79			F-t (145)								n -	j, fronter
104	Com	32	18	30	80	F-e			S-p		Na				Ad in step 8	j Norges idrettshøgskole	j, fronter
106	Com Scrolling PN entry words	25	20	24	69			F-t (145)								n -	j, fronter
107	App	19	35	19	73				S-p							n -	j, fronter
108	App	32	25	27	84			F-t (145)	S-p							n -	n

109	App	32	16	30	78			F-t 145						Re in step 8		j Litt pedagogikk og fagdidaktikk i Musikk og KRL årsstudium (Fjellhaug skoler)	n
110	App	29	34	36	99			F-t 145	S-p						Ad	n -	n
111	Rej	29	15	27	71			F-t 145				Fa		Re		n -	n
201	App	27	24	32	83			F-t 145								n -	n
202	App	38	13	35	86			F-t (145)	S-p							n -	n
203	Rea	26	25	24	75			F-t (14)					Fo	Re		n -	n, Har skrevet noe om enhets-skoleprinsip pet i forbindelse med lesing til eksamen, men har ikke svart/sett på en liknende oppgave.
204	App	33	31	28	92			F-t ((145))	S-p in step 4	(Ta2)						n -	j, fronter
205	App	36	21	32	89			F-t (14)		Ta						n -	j, fronter
206	Com	26	23	23	72	F-e			S-p							n -	n
207	App	36	15	27	78			F-t	S-p in							n -	j, i klassen

								(145)	step 4								
208	Rea	27	24	28	79			F-t (14)		Ta		Fa			Ad	n -	j, fronter
210	App	32	24	34	90			F-t (145)	S-p							n -	n
211	Rea	29	12	36	77	F-e		F-t 145					Fo	Re		n -	j, fronter, i klassen
212	App	37	15	22	74			F-t 145	S-p	(Ta_{ped})						n -	n
213	App	23	23	22	68			F-t 145								n -	j, fronter
214	Com Scrolling PN entry words	36	17	36	89		Ph	F-t ((145))	S-p					Re		n -	n
215	App	30	27	32	89			F-t (145)								n -	n
216	App	29	20	24	73	F-e		F-t (145)								n -	n
217	App	38	13	35	86			F-t 145						Re		n -	n
221	App	25	25	18	68	F-e		F-t (145)	S-p in step 4							j Kunst og håndverk i Volda, Faglærer kunsthåndverk i Oslo	n
222	App	36	21	27	84	F-e	(Ph)	F-t 145								n -	n
224	Enr	30	17	37	84	F-e	(Ph)	F-t 145								n -	j, i klassen
301	App	28	20	36	84			F-t	S-p							n -	n

								(145)									
302	Enr	20	27	22	69			F-t 14	S-p							n Næhæhei	n
303	App	28	20	24	72	F-e			S-p		Na					n Nei, men har hatt pedagogisk lederkurs i speideren.	j, fronter
304	Enr	27	21	25	73			F-t 14		Ta		Fa	Fo			n -	n
305	App	28	27	26	81	F-e		F-t 145	S-p							n -	n
306	Enr	31	19	29	79			F-t 145	S-p			Fa				n -	j, arbeidet med: Satt opp en disposisjon, diskutert med medelever.
307	App Scrolling PN entry words	33	20	31	84			F-t (145)	S-p		Na					n -	n
308	Enr	30	22	25	77				S-p	(Taped) (Ta2)		Fa				n -	n
309	App	26	17	21	64				S-p		Na					n -	j, fronter
311	Rea	32	13	28	73		Ph	F-t (145)	S-p		Na					j Et kurs i "Hvordan mennesker lærer" i pedagogikk på UiO.	n

312	Rea	29	17	34	80	F-e	Ph	F-t 145								n -	n
313	App	36	20	28	84			F-t 15						Re		j Folkehøgskole 1 år, PPL (psykologi, pedagogikk og ledelse).	j, fronter
314	Com	28	24	26	78	(F-e)		F-t 14(5)						Re		n -	n
315	Enr	26	23	17	66			F-t 14	S-p	(Ta_{ped})		Fa	Fo			n -	j, fronter
316	Rej	30	23	35	88				S-p	Ta		Fa				n -	n
317	App	36	10	24	70				S-p		Na					n -	j, fronter
318	Enr	33	16	34	83			F-t (145)		(Ta2)		Fa	Fo	Re		n -	n
319	App	35	20	33	88				S-p							j Årsstudium i psykologi.	j, arbeidet med: Laget disposisjon til eksamensfo rberedende undervisnin g.
320	Rea	34	15	35	84			F-t (14)				Fa				n -	n
321	App	37	19	35	91			F-t ((145))	S-p					Re		n -	j, fronter
322	App	38	17	28	83			F-t (15)	S-p		Na					j Ex.paed. v/Blindern.	n
323	App	25	19	30	74			F-t (145)		(Ta2)						n -	n

325	Com	37	27	17	81	F-e		F-t 14(5)	S-p					Re in step 8		n -	n
327	App Scrolling PN entry words	31	18	29	78	(F-e)		F-t (15)	S-p in step 4							n -	n
329	App	29	22	29	80			F-t 145	S-p							n -	j, arbeidet med: Satt opp en slags disposisjon.
330	App	37	25	17	79			F-t 14	S-p		Na					n -	n
		Deep	*Surface*	*Strategic*	*Total*												
	Mean value learn. style	30, 72	20, 56	28, 06	79, 33												

Appendix 22 The students' brainstorm versus the teachers' word associations

This appendix provides a comparison between the students' terms used in the structured brainstorm in terminological step 3 in the *Motivation task* and the teacher's word associations to the work task facet terms. The informants worked in Norwegian, and the data is not translated in this appendix.

The Motivation task

Kunnskapsløftet tar opp motivasjon for læring og læringsstrategier (Læreplanverket for Kunnskapsløftet s. 32). Gjør rede for begrepene læring og undervisning. Drøft motivasjonens betydning for læringen.

Work task facets

KUNNSKAPSLØFTET

MOTIVASJON

LÆRING

LÆRINGSSTRATEGIER

UNDERVISNING

The teacher's word associations to the work task facets

The 5 work task facet terms were processed an unequal number of times, totally 19 processings. The teachers produced 99 associations distributed on 89 different terms (10 concurrences). For each work task term the associations produced by several teachers are listed according to descending frequency, afterwards the associations produced only are listed alphabetically.

KUNNSKAPSLØFTET (processed by 1 teacher, 6 different associations):

Elevers læring
Grunnleggende ferdigheter
Læreplaner
Læreplanverket for Kunnskapsløftet (LK06)
Pisa
St.meld. nr. 30 (2003-2004) Kultur for læring

MOTIVASJON (processed by 6 teachers, 28 different associations):

Læring *(4 times)*
Attribusjonsteorier *(2 times)*
Mestring *(2 times)*

Attribusjon
Behov
Belønning
Driv
Drivkrefter
Forutsetninger for læring
Holdninger
Identitet
Indre motivasjon
Indre/ytre motivasjon
Interesser
Ledelse
Lyst
Manglende motivasjon
Mening
Mestringsmotivasjon
Pedagogikk
Prestasjonsmotivasjon
Pygmalioneffekten
Relasjonskompetanse
Self-efficacy
Sosial mestring
Stimuli
Vegring
Ytre motivasjon

LÆRING (processed by 8 teachers, 42 different associations):
Lek *(5 times)*
Kunnskap *(4 times)*
Motivasjon *(4 times)*
Kognitiv konstruktivisme *(2 times)*
Læringspsykologi *(2 times)*
Mestring *(2 times)*
Sosialisering *(2 times)*
Sosialkonstruktivisme *(2 times)*
Utvikling *(2 times)*
Aktiviteter
Behavioristiske teorier
Behavioristiske tilnærminger til læring
Danning
Elever og studenter og kunnskap
Elevforutsetninger
Erfaringer
Fag
Ferdigheter
Forandring
Forståelse
Holdninger
Individer
Innsikt

Kognitiv psykologi
Kognitive teorier
Kommunikasjon
Kompetanseheving
Kunnskapsoversikt
Kvalifisering
Læreforutsetninger
Lærere
Læringsteorier
Læringsutbytte
Mål
Opplevelser
Pedagogikk
Psykoanalytiske tilnærminger til læring
Relasjonskompetanse
Sosiokulturelle tilnærminger til læring
Testing
Utforsking
Vurdering

LÆRINGSSTRATEGIER (processed by 1 teacher, 5 different associations):
Arbeidsmåter
Elevforutsetninger
Elevplanlegging
Metakognitive læringsstrategier
Selvregulert læring

UNDERVISNING (processed by 3 teachers, 18 different associations):
Didaktikk *(4 times)*
Klasseledelse *(3 times)*
Arbeidsformer
Fagdidaktikk
Gruppearbeid
Helklasseundervisning
Individuelt arbeid
Instruksjon
Læreplaner
Lærerarbeid
Læringspsykologi
Læringssituasjoner
Pedagogikk
Proksimale utviklingssone (Den)
Samlingsstunder
Skolegang
Undervisningspraksis
Utdanning

Next page: Appendix 2 continued

Table comparing the students' vocabulary (in the structured brainstorm in terminological step 3 in the main session) with the teachers' word associations. Work task facet terms are listed in *CAPITAL ITALIC* letters. Non-topical terms and phrases are excluded.

<table>
<tr><td rowspan="2">The students' brainstorm vocabulary

Terms in the structured brainstorm in terminological step 3
(26 students, 167 different terms – variants are counted as one, e.g., Behaviorismen and Behaviorisme – some concurrences, but frequencies are not listed)

Work task facet terms in CAPITAL ITALIC letters</td><td colspan="2">The teachers' word associations vocabulary

The teachers' word associations to the 5 work task facets (89 different associations)</td></tr>
<tr><td>Teachers' word associations which are also found in the students' brainstorms (33 terms)

Work task facet terms in CAPITAL ITALIC letters</td><td>Teachers' word associations which are not found in the students' brainstorms (56 terms)

17 terms (30 %) are indicated with an asterix (*) which means that they are selected by the students in terminological step 8</td></tr>
<tr><td colspan="2">33 of the teachers' word associations are also produced in the students' brainstorming (not counting the 5 work task terms), which means that the students produce 37 % of the teachers' terms themselves in the initial part of the work task.</td><td>63 % of the teachers' terms are not found in the students' brainstorms.</td></tr>
<tr><td>Akkomodasjon</td><td></td><td></td></tr>
<tr><td>Aktivitet/deltakelse</td><td>Aktiviteter (counted as the same term)</td><td></td></tr>
<tr><td>Aktivitetspedagogikk</td><td></td><td></td></tr>
<tr><td>Alder</td><td></td><td></td></tr>
<tr><td>Angst for å lykkes</td><td></td><td></td></tr>
<tr><td>Ansvar</td><td></td><td></td></tr>
<tr><td>Arbeidsformer</td><td>Arbeidsformer</td><td></td></tr>
<tr><td>Arbeidsmetoder</td><td></td><td></td></tr>
<tr><td>Arbeidsmiljø</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Arbeidsmåter</td></tr>
<tr><td>Assimilasjon</td><td></td><td></td></tr>
<tr><td>Atkinsons teori</td><td></td><td></td></tr>
<tr><td>Attribusjon</td><td>Attribusjon</td><td></td></tr>
<tr><td>Attribusjonsteori</td><td>Attribusjonsteorier</td><td></td></tr>
<tr><td>Behaviorismen (also: Behaviorisme)</td><td></td><td></td></tr>
<tr><td>Behavioristiske teorier</td><td>Behavioristiske teorier</td><td></td></tr>
<tr><td></td><td></td><td>* Behavioristiske tilnærminger til læring</td></tr>
</table>

		(cited as Behaviorismen in terminological step 8)
		* Behov
Belønning	Belønning	
Bruner		
		* Danning
Den didaktiske relasjonsmodellen *(also: Didaktisk relasjonsmodell)*		
Den proksimale utviklingssone	Den proksimale utviklingssone	
Dewey		
		* Didaktikk
		Driv
		Drivkrefter
Dårlig selvbilde		
Ego-orientert		
Elev-lærer-relasjonen		
Elevens målforutsetning		
Elevens rolle		
Elevens utbytte		
Elever		
		Elever og studenter og kunnskap
		Elevers læring
Elevforutsetninger	Elevforutsetninger	
Elevmedvirkning		
		Elevplanlegging
Elevstyrt undervisning		
Engasjement		
Engasjere eleven til å arbeide selv		
Erfaring	Erfaringer	
		Fag
		* Fagdidaktikk
		Ferdigheter
Fokus på individ		
Fokus på læreren		
		Forandring
Former for læring		
Former for undervisning		

Forståelse	Forståelse	
		*Forutsetninger for læring
Forventninger		
Gardner		
Gjenfortelle		
God/ond sirkel		
		Grunnleggende ferdigheter
Gruppearbeid	Gruppearbeid	
		Helklasseundervisning
Historisk syn		
Holdning	Holdninger	
Humanistiske teorier		
		* Identitet
		Individer
Individorientert		
Individuell opplæringsplan (IOP)		
Individuelt arbeid	Individuelt arbeid	
Individuelt/felles		
Indre motivasjon	Indre motivasjon	
Indre/ytre faktorer		
Indre/ytre motivasjon	Indre/ytre motivasjon	
Indre prosess		
		Innsikt
		Instruksjon
Intelligenser		
Interesser *(also: Interesse)*	Interesser	
IUP		
Kausal sirkularitet		
Kjennskap til elevene		
Kjønnsforskjeller		
		*Klasseledelse
Klassemiljø		
Klassen		
Kognitiv konstruktivisme	Kognitiv konstruktivisme	
		* Kognitiv psykologi

Kognitiv teori	Kognitive teorier	
	Kommunikasjon	
Kompetanse	Kompetanseheving *(counted as the same term)*	
Kompetansemål		
Kompetent annen		
Konkurranse		
Konstruktivisme *(also: Konstruktivismen)*		
Konstruktivistiske teorier		
Konteksten begrenser		
Kunnskap	Kunnskap	
KUNNSKAPSLØFTET	*KUNNSKAPSLØFTET*	
		Kunnskapsoversikt
		Kvalifisering
L97		
LK06	Læreplanverket for Kunnskapsløftet (LK06)	
Learning by doing		
		Ledelse
Lek	Lek	
Lese		
Lese høyt		
		Lyst
		Læreforutsetninger
Lærelyst		
Læreplan	Læreplaner	
Læreplanutvikling		
Lærer strukturerer arbeidet		
		Lærerarbeid
Læreren	Lærere	
Læreren som motivator *(also: Lærerens rolle – motivator)*		
Lærerens ansvar		
Lærere (faktor for motivasjonen, kan påvirke)		
Lærerstyrt undervisning		
LÆRING	*LÆRING*	

Læring mellom mennesker		
Læringsformer		
Læringsplakaten, generelle delen		
		* Læringspsykologi
		* Læringssituasjoner
Læringsstiler		
LÆRINGSSTRATEGIER	*LÆRINGSSTRATEGIER*	
Læringsteorier *(also: Læringsteori, Læringsteoriene)*	Læringsteorier	
		Læringsutbytte
		Manglende motivasjon
Maslow		
		Mening
Meningsfylt		
Mestring	Mestring	
		* Mestringsmotivasjon
		* Metakognitive læringsstrategier
MOTIVASJON	*MOTIVASJON*	
Motivasjon for å lære		
Motivasjon for å lære bort		
Motivasjonsfaktorer		
Motivasjonsteorier *(also: Motivasjonsteori)*		
Motivere eleven til å arbeide selv		
Mål/innhold	Mål	
Nivå		
Nærmiljø		
Oppgavens vanskelighetsgrad		
		Opplevelser
Opprettholde motivasjon		
		* Pedagogikk
Piaget		
Pintrich og Schunk		
		Pisa
Planlegging		
Positiv og negativ		
Prestasjonsangst		

Prestasjonsmotivasjon	Prestasjonsmotivasjon	
Prestasjonsteori		
		Psykoanalytiske tilnærminger til læring
		Pygmalioneffekten
Rammefaktorer		
Rammefaktorer for undervisning		
Relasjon elev-elev		
Relasjon lærer-elev		
Relasjoner		
		Relasjonskompetanse
Relevant		
Ringe rundt		
Samarbeid med hjemmet		
Samarbeide		
		Samlingsstunder
Se alle elevene		
		* Self-efficacy
Selvbilde		
Selvet/identitet		
		* Selvregulert læring *(cited as Selvregulerte in terminological step 8)*
Signifikante andre		
Skape motivasjon		
Skinner		
Skole-hjem-samarbeid		
		Skolegang
Skrive		
Skrive referat		
Skrive stikkord		
		Sosial mestring
		Sosialisering
		Sosialkonstruktivisme
Sosiokulturell læring		
Sosiokulturell teori *(also: Sosiokulturelle [læringsteorier])*	Sosiokulturelle tilnærminger til læring	
Språket		
		St.meld. nr. 30 (2003-

		2004) Kultur for læring
		Stimuli
Støttens betydning		
Symbolsk interaksjonisme		
Teorier		
		Testing
Tilpasset opplæring (TPO)		
Tilrettelegging *(also: Tilrettelegge for læring)*		
Ulike faktorer		
Ulike intelligenser		
Ulike læringsformer		
Ulike læringsstrategier		
Ulike læringsstrategier/metoder		
Ulike læringsteorier		
UNDERVISNING	*UNDERVISNING*	
Undervisningsformer		
Undervisningsmetoder		
		* Undervisningspraksis
Undervisningsstrategier		
		Utdanning
		Utforsking
Utvikling av individ (sosialt og faglig)	Utvikling	
Utviklingssoner		
VAKT-prinsippet *(also: VAKT-prinsipp)*		
Variere form av undervisning		
Variere læremidler		
Variere organisering		
Variert undervisning		
Varierte arbeidsmetoder		
Varierte arbeidsmåter		
		Vegring
Veileder		
Vurdering	Vurdering	
Vurdering av læringen		
Vygotskij		
Ytre motivasjon	Ytre motivasjon	

Appendix 23 Terminological steps 1, 5 and 8 in the *Motivation task*

This appendix contains the students' selection of work task facet terms (step 1), their formulation of tentative search terms (step 5), and their revised formulation after having used PedNett (step 8), for one of the simulated work task, i.e. the *Motivation task* (worked on by 26 informants). The informants worked in Norwegian, and the data is not translated in this appendix. The student's vocabulary in steps 5 and 8 are characterized as to whether the terms concur with entries in *Pedagogisk ordbok* (Bø & Helle 2008) and in PedNett. Non-topical terms and phrases are not included.

The table contains the following columns:

Step 1 Selection	Work task facet terms (emphasized by grey background in the table)
Pedagogisk ordbok	X=the term in step 5 occurs in *Pedagogisk ordbok* (Bø & Helle 2008)
PedNett occurrence	Whether the term in step 5 occurs in PedNett
	P=word node i PedNett
	PF=word node in the PedNett cluster for the work task, i.e. either as a work task facet term or as a word association produced to a work task facet term
	T=work task facet term
	S=self-produced term from step 2/3/4
Step 5 Formulation	Tentative search terms
Pedagogisk ordbok	X=the term in step 5 occurs in *Pedagogisk ordbok* (Bø & Helle 2008)
PedNett occurrence	P=word node i PedNett
	PF=word node in the PedNett cluster for the work task, i.e. either as a work task facet term or as a word association produced to a work task facet term
	R=the word occurs in a relationship description in PedNett (only used in step 8)
	T=work task facet term
	S=self-produced term from step 2/3/4/5
Step 8 Formulation revision	
	Revised tentative search terms
	Each word counted once per informant (irrespective of the informant uses the same term in several search boxes)

Step 1 Selection	*Pedagogisk ordbok*	*PedNett occurrence*	*Step 5 Formulation*	*Pedagogisk ordbok*	*PedNett occurrence*	*Step 8 Formulation revision*
			32 different terms used in step 5: 27 terms produced by the informants, plus 5 work task facet terms Terms used by more than one informant, has the frequency indicated after the term, e.g., Indre motivasjon 3. No number after the term=the term is used by 1 informant.			49 different terms used in step 8: 9 P *(codes explained* 31 PF *on the* 3 R *previous page)* 2 T 4 S 61 PF terms in italics = 58 words in the PedNett cluster which are not used in step 8 + 3 PF terms which are also work task facet terms (T), not used in step 8 because the informants had used them already in step. PF terms totally: 5 work task facet terms + 31 PF used + 58 non-used = 94 terms.
				X		*Aktiviteter: Non-used PF*
				-		*Arbeidsformer: Non-used PF*
	-	P	Arbeidsmiljø			
				X		*Arbeidsmåter: Non-used PF*
	X	PF	Attribusjon	X	PF	Attribusjon 3
				X	PF	Attribusjonsteori 5 *(also: Attribusjonsteorier)*
				-	S not R	Bandura

	-	S		X	PF	Behaviorismen 2 *(PN node: Behavioristiske teorier)*
				-		*Behavioristiske tilnærminger til læring: Non-used PF*
				X	PF	Behov 2
				X	PF	Belønning
				-	PF	Danning
				X		*Den proksimale utviklingssone: Non-used PF*
				X	PF	Didaktikk 2
	X	P	Didaktisk relasjonsmodell *(Den didaktiske relasjonsmodellen)*			
				-		*Driv: Non-used PF*
				-		*Drivkrefter: Non-used PF*
				-		*Elever og studenter og kunnskap: Non-used PF*
				-		*Elevers læring: Non-used PF*
				X	PF	Elevforutsetninger 2
	-	S	Engelsen Kan læring planlegges?			
				-		*Elevplanlegging: Non-used PF*
				X		*Erfaringer: Non-used PF*
				-		*Fag: Non-used PF*
				X	PF	Fagdidaktikk
				X		*Ferdigheter: Non-used PF*
				-		*Forandring: Non-used PF*
				-		*Forståelse: Non-used PF*
				-	PF	Forutsetninger for læring 2
	-	S	Gardner			

	X	S	Generell del			
				X		*Grunnleggende ferdigheter: Non-used PF*
				-		*Gruppearbeid: Non-used PF*
				-		*Helklasseundervisning: Non-used PF*
				X	PF	Holdninger
				X	PF	Identitet 3
	-	S	Imsen Elevens verden			
				X		*Individer: Non-used PF*
				-		*Individuelt arbeid: Non-used PF*
	X	PF	Indre motivasjon 3	X	PF	Indre motivasjon 7
				-	S not R	Indre/ytre faktorer 2
				X		*Indre/ytre motivasjon: Non-used PF*
				X		*Innsikt: Non-used PF*
	X	R	Intelligens *(In R to Pedagogisk psykologi)*			
				-		*Instruksjon: Non-used PF*
				-		*Interesser: Non-used PF*
	X	P	IOP			
	-	S	IUP			
				-	PF	Klasseledelse 3
				-	PF	Kognitiv konstruktivisme
				X	PF	Kognitiv psykologi
				(X)		*Kognitive teorier: Non-used PF*
				X		*Kommunikasjon: Non-used PF*
				-		*Kompetanseheving: Non-used PF*
				X		*Kunnskap: Non-used PF*

Kunnskapsløftet	X	T	Kunnskapsløftet 2	X		*Kunnskapsløftet: Non-used PF, T*
				-		*Kunnskapsoversikt: Non-used PF*
				-		*Kvalifisering: Non-used PF*
				X		*Ledelse: Non-used PF*
				X		*Lek: Non-used PF*
				-		*Lyst: Non-used PF*
	X	PF	LK06	X	PF	LK06 3 (= Læreplanverket for Kunnskapsløftet)
				X		*Læreforutsetninger: Non-used PF*
				X	PF	Læreplaner
				-		*Lærerarbeid: Non-used PF*
				X		*Lærere: Non-used PF*
Læring	X	T	Læring 13	X		*Læring: Non-used PF, T*
	X	P	Læringsplakaten			
				-	P	Læringsprosesser
				X	PF	Læringspsykologi
				-	PF	Læringssituasjoner
	-	P	Læringsstiler	-	P	Læringsstiler
Læringsstrategier	X	T	Læringsstrategi *(also: Læringsstrategier)* 2	X		*Læringsstrategier: Non-used PF, T*
	-	S	Læringsstrategier i skolen *(inspired by the work task)*			
	X	PF	Læringsteorier *(also: Læringsteori)* 3	X	PF	Læringsteorier 3
				-		*Læringsutbytte: Non-used PF*
				-	S not R	Maslow 4
				X	S ikke R	Maslows behovshierarki 2

	-	S not R	Maslows behovspyramide 2			
				-		*Manglende motivasjon: Non-used PF*
				-		*Mening: Non-used PF*
	X	PF	Mestring 2	X	PF	Mestring 2
				X	PF	Mestringsmotivasjon 2
				-	PF	Metakognitive læringsstrategier
Motivasjon	X	T	Motivasjon 16	X	T	Motivasjon
	-	R	Motivasjon for læring *(In R to Motivasjon)*			
	-	work task	Motivasjonens betydning *(Formulation taken from the work task)*			
	-	S	Motivasjonsfaktorer i skolen			
	-	R	Motivasjonsteori	-	R	Motivasjonsteori *(also: Motivasjonsteorier) (R to Motivasjon)*
				X		*Mål: Non-used PF*
				X		*Opplevelser: Non-used PF*
	X	PF	Pedagogikk 2	X	PF	Pedagogikk
				-	P	Piaget 2
				X		*Pisa: Non-used PF*
				X	PF	Prestasjonsmotivasjon
				X		*Psykoanalytiske tilnærminger til læring: Non-used PF*
				X		*Pygmalioneffekten: Non-used PF*
				X		*Relasjonskompetanse: Non-used PF*
				-		*Samlingsstunder: Non-used PF*
				X	PF	Self-efficacy 2
				-	PF	Selvregulerte *(Selvregulert læring)*

				-	P	Skole/hjem-samarbeid
				-		*Skolegang: Non-used PF*
				-	P	Skolen *(Skole)*
				-		*Sosial mestring: Non-used PF*
				X		*Sosialisering: Non-used PF*
				X		*Sosialkonstruktivisme: Non-used PF*
				X	P	Sosiokulturell teori 2 *(Sosiokulturelle teorier)*
				X		*Sosiokulturelle tilnærminger til læring: Non-used PF*
				-		*St.meld. nr. 30 (2003-2004) Kultur for læring: Non-used PF*
				X	P	Stadieteorier
				X		*Stimuli: Non-used PF*
				-	R	Strategier *(Is found in 8 relationship descriptions)*
				-		*Testing: Non-used PF*
	X	P	Tilpasset opplæring	X	P	Tilpasset opplæring i skolen *(Tilpasset opplæring)*
Undervisning	X	T	Undervisning 9	X	T	Undervisning 4
	-	P	Undervisningsmetoder 3			
				-	PF	Undervisningspraksis
				-		*Utdanning: Non-used PF*
				X		*Utforsking: Non-used PF*
				X		*Utvikling: Non-used PF*
				-		*Vegring: Non-used PF*
				X	PF	Vurdering

	X	R	Vurdering i skolen	X	R	Vurdering i skolen *(In R to Vurdering-Prøver, getting to Vurdering from Læring)*
				-	P	Vygotskij 2
	X	PF	Ytre motivasjon 2	X	PF	Ytre motivasjon 7

Appendix 24 Characteristics of formulation behaviour

This appendix aims at indicating to what extent formulation behaviours co-occur (cf. section 4.5). Inclusion means that one formulation behaviour applies to a sub-set of another formulation behaviour – e.g., 6 of the 45 informants exhibiting facet-trusting, also exhibit phrasing – so phrasing is included in facet-trusting. Some combinations of formulation behaviours never co-occur – these are indicated as dark grey cells in the illustration on the next two pages. Most pairs of formulation behaviours, however, intersect to a certain degree.

The characteristics *large*, *medium*, and *small* intersection used in the illustration in appendix 24 are to be interpreted like this: The numbers inside the circles indicate the number of informants who exhibit each formulation behaviour. For each set of two formulation behaviours, I have indicated how many informants exhibit both of them, i.e. the number of informants contained in the intersection between the two. I have calculated how large amount of the formulation behaviour occurring with the smallest number of informants of the two, which is also found with the other formulation behaviour. The characteristic *large* intersection is used for amounts above 0,6, *medium* is used for the span 0,4-0,6, whereas *small* covers amounts less than 0,4. Consider, e.g., the intersection between facet-trusting and first-patching: Facet-trusting appears with 45 informants (of which 37 do *not* exhibit first-patching and 8 do), whereas first-patching appears with 10 informants (of which 2 informants do *not* exhibit facet-trusting and 8 do) – thus, a large intersection (0,8). This is illustrated by a large circle (facet-trusting) intersecting with a smaller circle (first-patching). The notion of large, medium, and small is relative to the amount of the smallest circle intersecting with the larger, i.e. it does not refer to a fixed number of informants. Thus, a large intersection in the illustration can be e.g., 4 (as in the intersection between facet-embracing and phrasing), but it can just as well be 22 (as in the intersection between facet-trusting and self-production).

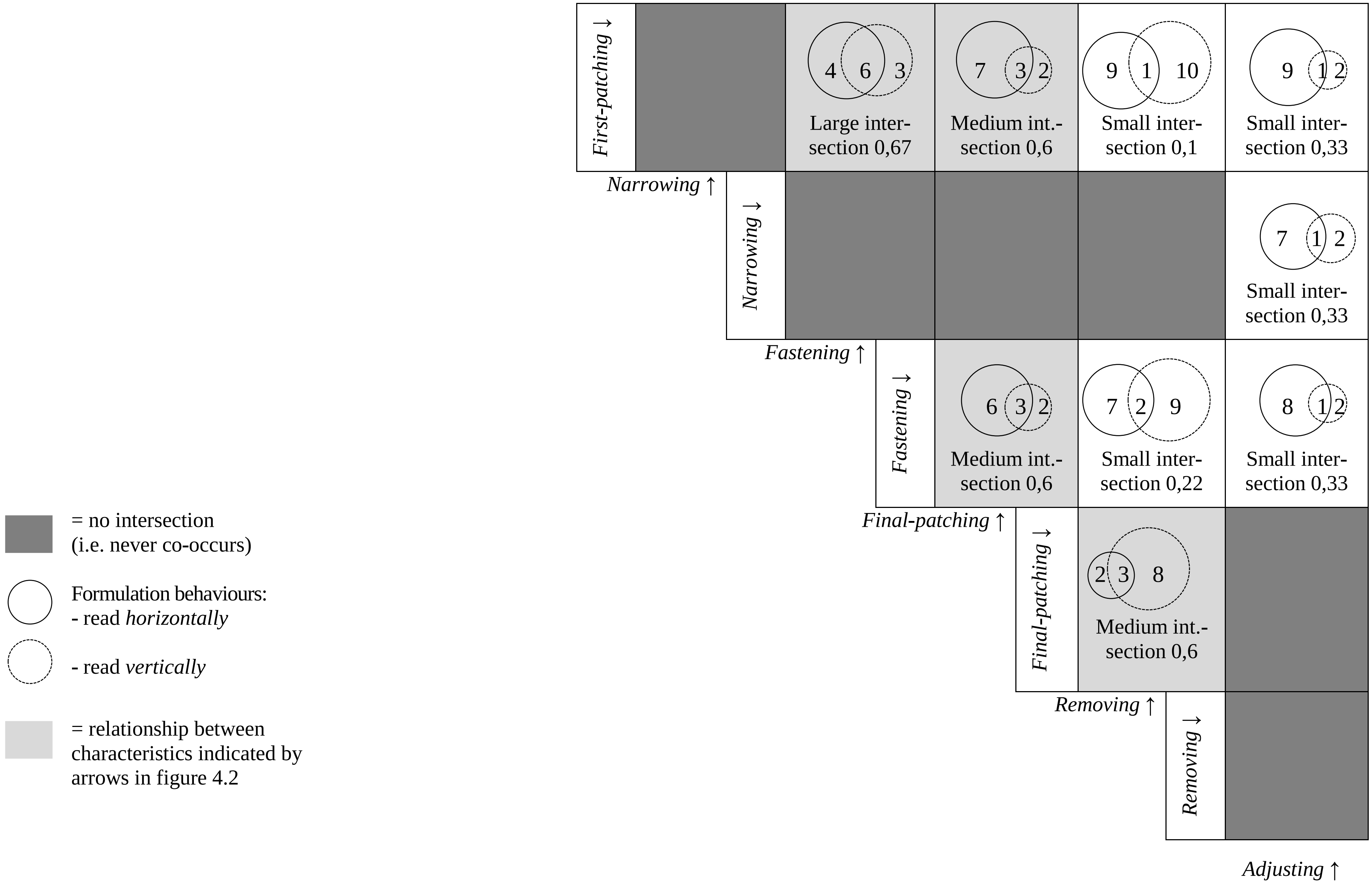
When there is a large intersection between two formulation behaviours, I call it a *strong* relationship, whereas a medium intersection is considered a *medium strong* relationship. It is of little use to consider pairs involving either facet-trusting (45) or self-production (31), as these two characteristics are assigned to a majority of the informants. If we leave out these two, we find five pairs of formulation behaviours which are *strong or medium strong, indicated by light grey cells* in the illustration on the next pages. They include the strong relationships phrasing→facet-embracing and fastening→first-patching, and the medium strong relationships final-patching→removing, final-patcing→fastening, and final-patching→first-patching. This is to be interpreted as, e.g., ‘students exhibiting phrasing (i.e. using phrases rather than words) are also often facet-embracing (i.e. select many work task facet terms)’. Cf. illustration on the next pages:

	Phrasing ↓ (6)	*Facet-trusting* ↓ (45)	*Self-production* ↓ (31)	*First-patching* ↓ (10)	*Narrowing* ↓ (8)	*Fastening* ↓ (9)	*Final-patching* ↓ (5)	*Removing* ↓ (11)	*Adjusting* ↓ (3)
Facet-embracing ↓ (14)	10 4 2 Large intersection 0,67	3 11 34 Large intersection 0,79	7 7 24 Medium int.-section 0,5		12 2 6 Small intersection 0,25		13 1 4 Small intersection 0,2	11 3 8 Small intersection 0,27	13 1 2 Small intersection 0,33
Phrasing ↓		6 39 Inclusion	4 2 29 Small intersection 0,33		5 1 7 Small intersection 0,17			5 1 10 Small intersection 0,17	
Facet-trusting ↓			23 22 10 Large intersection 0,71	37 8 2 Large intersection 0,8	41 4 4 Medium int.-section 0,5	38 7 2 Large intersection 0,78	40 5 Inclusion	34 11 Inclusion	43 2 1 Large intersection 0,67
Self-production ↓				26 5 5 Medium int.-section 0,5	23 8 Inclusion	27 4 5 Medium int.-section 0,44	30 1 4 Small intersection 0,2	28 3 8 Small intersection 0,27	29 2 1 Large intersection 0,67

= no intersection (i.e. never co-occurs)

Formulation behaviours:
- read *horizontally*
- read *vertically*

= relationship between characteristics indicated by arrows in figure 4.2


First-patching ↓
4 6 3
Large inter-
section 0,67
7 3 2
Medium int.-
section 0,6
9 1 10
Small inter-
section 0,1
9 1 2
Small inter-
section 0,33
Narrowing ↑
Narrowing ↓
7 1 2
Small inter-
section 0,33
Fastening ↑
Fastening ↓
6 3 2
Medium int.-
section 0,6
7 2 9
Small inter-
section 0,22
8 1 2
Small inter-
section 0,33
Final-patching ↑
Final-patching ↓
2 3 8
Medium int.-
section 0,6
Removing ↑
Removing ↓
Adjusting ↑
= no intersection
(i.e. never co-occurs)
Formulation behaviours:
- read *horizontally*
- read *vertically*
= relationship between
characteristics indicated by
arrows in figure 4.2

Appendix 25 Terminological steps exemplifying the PedNett user types

This appendix demonstrates terminological steps 1-8 for six informants exemplifying the PedNett user types Applicator, Combiner, Reactivator, Applicator, Aloofer, and Rejecter.

Work task used in informant session: Cites the work task used, with work task facets in italics. Steps 1-8: Contains what the informant wrote in the main questionnaire when working on the terminological steps. Step 1 (selection), step 2 (brainstorming), step 3 (structuring), step 4 (clarification), step 5 (formulation), step 6 (structure revision), step 7 (clarification revision), and step 8 (formulation revision). Information in square brackets in steps 6, 7 and 8 contains abstracts from the corresponding steps 3, 4, and 5 (e.g., column headers from step 3 cited in step 6), when such context is needed to make sense of what the informant has added in the questionnaire during PedNett use.

Cf. next page:

<table>
<tr><td colspan="3">A typical PedfNett Applicator
Demonstrated by one out of 32 Applicator informants</td></tr>
<tr><td colspan="3">Work task used in informant session: The Motivation task (work task facets in italics): Kunnskapsløftet tar opp motivasjon for læring og læringsstrategier (Læreplanverket for Kunnskapsløftet s. 32). Gjør rede for begrepene læring og undervisning. Drøft motivasjonens betydning for læringen.</td></tr>
<tr><td colspan="3">Step 1 (selection) Læringsstrategier, Læring, Undervisning, Motivasjon</td></tr>
<tr><td colspan="3">Step 2 (brainstorming) Question marks made by the informant
Undervisning: definisjoner/forklaringer – eksempler (?)
Læring: definisjoner/forklaringer – eksempler (?)
Motivasjon: drøftes, men kan likevel være greit med en kort redegjørelse og definisjon
Elever og læringsstrategier (teorier (?), forskjellige)
Lærere</td></tr>
<tr><td>Step 3 (structuring)</td><td>Step 4 (clarification)</td><td>Step 5 (formulation)</td></tr>
<tr><td>Læringsstrategier: teorier, forskjellige typer strategier

Læring: definere/forklare/eksempler (?)

Undervisning: definere/forklare/eksempler (?)

Motivasjon: elever, lærere (faktor for motivasjonen, kan påvirke), kort redegjørelse/definisjon</td><td>Læringsteorier

Læringsstrategier

Motivasjon (faktorer)</td><td>Motivasjonsfaktorer i skolen eller “undervisning”</td></tr>
<tr><td>Step 6 (structure revision)</td><td>Step 7 (clarification revision)</td><td>Step 8 (formulation revision)</td></tr>
<tr><td>[Læringsstrategier] [teorier] stadieteorier, (Piaget), sosiokulturelle teorier (Vygotskij), [forskjellige typer strategier] elevforutsetninger, selvregulert læring og andre arbeidsmåter

[Motivasjon] mestring, læring, [motivasjonen] indre og ytre motivasjon, mening</td><td>[Læringsteorier] stadieteorier (Piaget) og sosiokulturelle teorier (Vygotskij)

[Læringsstrategier] elevforutsetninger, tilrettelegging av undervisning i forhold til mestring og økt motivasjon

[Motivasjon (faktorer)] mestring, indre/ytre motivasjon, mening med undervisningen/læringen</td><td>Stadieteorier Piaget

Sosiokulturell teori Vygotskij

Indre ytre motivasjon</td></tr>
</table>

<table>
<tr><td colspan="3">A typical Term Combiner
Demonstrated by one out of 6 Combiner informants</td></tr>
<tr><td colspan="3">Work task used in informant session: The Motivation task (work task facets in italics): Kunnskapsløftet tar opp motivasjon for læring og læringsstrategier (Læreplanverket for Kunnskapsløftet s. 32). Gjør rede for begrepene læring og undervisning. Drøft motivasjonens betydning for læringen.</td></tr>
<tr><td colspan="3">Step 1 (selection) Motivasjon, Læring, Læringsstrategier, Undervisning, Drøft, Betydning</td></tr>
<tr><td colspan="3">Step 2 (brainstorming)
Hva er læring? Definisjon
Klasserommet
Læringsteorier
Vygotskij
Piaget
Dewey
Hva er undervisning? Definer
Motivasjon – teorier
Attribusjonsteori
Forventninger
Hva er god læring
Hva sier LK06
Varierte arbeidsmetoder VAKT-prinsipp
Tilpasset opplæring
Hvorfor er motivasjon viktig? Læring</td></tr>
<tr><td>Step 3 (structuring)</td><td>Step 4 (clarification)</td><td>Step 5 (formulation)</td></tr>
<tr><td>Motivasjon: teorier, attribusjonsteori, forventninger, positiv og negativ, dårlig selvbilde, viktig/hvorfor, belønning, indre/ytre

Læring: kunnskap, kompetanse

Læringsstrategier: VAKT-prinsippet, varierte arbeidsmetoder

Undervisning: Piaget, Vygotskij, Dewey, varierte arbeidsmetoder, tilpasset opplæring

Drøft: -

Betydning: -</td><td>Læring – definisjon

Motivasjon – teorier

Læringsstrategier

Undervisning</td><td>Læring + definisjon

Motivasjon + teorier</td></tr>
<tr><td>Step 6 (structure revision)</td><td>Step 7 (clarification revision)</td><td>Step 8 (formulation revision)</td></tr>
<tr><td>[Motivasjon] definisjoner, mestring, forutsetninger for læring, lyst, manglende motivasjon</td><td>Læringsteorier

Motivasjon</td><td>Undervisning + didaktikk

Undervisning + klasseledelse
Continues on next page:</td></tr>
</table>

[Læring] mestring, utvikling, erfaringer, læringsutbytte [Læringsstrategier] [VAKT-prinsippet] <strøket ut> elevplanlegging, definisjon: lære om egen læring som gjør at man lærer hvordan man skal gripe tak i en oppgave for å kunne løse den <denne definisjonen er avskrift av relasjonsbetegnelsen til Metakognitive læringsstrategier i PedNett> [Undervisning] didaktikk, klasseledelse, pedagogikk, klasseromsorganisering, arbeidsformer, gruppearbeid, helklasseundervisning, individuelt arbeid	Attribusjonsteori Arbeidsmåter Didaktikk Klasseledelse Arbeidsformer Pedagogikk	Pedagogikk + undervisning Læring + motivasjon Læringsteorier Motivasjonsteorier Motivasjonsteori + attribusjonsteori

<table>
<tr><td colspan="3">A typical Term Reactivator
Demonstrated by one out of 6 Reactivator informants</td></tr>
<tr><td colspan="3">Work task used in informant session: The Comprehensive school task (work task facets in italics): Gjør rede for enhetsskolebegrepet og vurder hvordan dette står i sammenheng med begrepene likhet, likeverd og inkludering. Drøft hvordan du som lærer vil legge til rette for en inkluderende opplæring i en flerkulturell skole.</td></tr>
<tr><td colspan="3">Step 1 (selection) Enhetsskolebegrepet, Likhet, Likeverd, Inkludering, Inkluderende opplæring, Flerkulturell skole</td></tr>
<tr><td colspan="3">Step 2 (brainstorming)
Enhetsskolebegrepet
Likhet
Likeverd
Identitet
Sosialisering
Danning
Inkludering/integrering
Flerkulturell skole
LK06
L97
Tilpasset opplæring
Skole-hjem-samarbeid</td></tr>
<tr><td>Step 3 (structuring)</td><td>Step 4 (clarification)</td><td>Step 5 (formulation)</td></tr>
<tr><td>Enhetsskolebegrepet: LK06, Læringsplakaten

Likhet: -

Likeverd: -

Inkludering: -

Inkluderende opplæring: tilpasset opplæring, skole-hjem-samarbeid, sosialisering, identitet, danning

Flerkulturell skole: -</td><td>Den flerkulturelle skolen

Enhetsskolebegrepet

Inkluderende opplæring

LK06/Læringsplakaten

TPO

Skole-hjem-samarbeid

Identitet/sosialisering

Danning</td><td>Enhetsskolen</td></tr>
<tr><td>Step 6 (structure revision)</td><td>Step 7 (clarification revision)</td><td>Step 8 (formulation revision)</td></tr>
<tr><td>[Enhetsskolebegrepet <endret til> Enhetsskole] fellesskole, foreldresamarbeid, likeverd, skole for alle, skolehistorie

[Likhet] likeverd

[Inkludering] fellesskole, flerkulturell pedagogikk, likestilling, mangfold,</td><td>-</td><td>[Enhetsskolen <-n fjernet>] Enhetsskole

Inkludering

Flerkulturell skole

Continues on next page:</td></tr>
</table>

skolehistorie, spesialpedagogikk [Flerkulturell skole] immigrasjon, mangfold og fellesskap, tradisjonell kulturvariasjon		

<table>
<tr><td colspan="3">A typical Structure Enricher
Demonstrated by one out of 7 Enricher informants</td></tr>
<tr><td colspan="3">Work task used in informant session: The Motivation task (work task facets in italics): Kunnskapsløftet tar opp motivasjon for læring og læringsstrategier (Læreplanverket for Kunnskapsløftet s. 32). Gjør rede for begrepene læring og undervisning. Drøft motivasjonens betydning for læringen.</td></tr>
<tr><td colspan="3">Step 1 (selection) Læring, Undervisning, Motivasjon</td></tr>
<tr><td colspan="3">Step 2 (brainstorming)
Definisjon læring
Kan læring planlegges?
Hva er læring?
Ulike læringsstiler
Sosiokulturell – Vygotskij – utviklingssoner
Kognitivt – Piaget – skjema
Definisjon undervisning
Legge til rette for elevene
Forutsigbarhet
Legge opp til nivået elevene er på, interesser
Motivasjon
Mestring
Dårlig sirkel om man ikke mestrer
Indre/ytre faktorer
Indre absolutt test
Ønske om å lære
Maslow</td></tr>
<tr><td>Step 3 (structuring)</td><td>Step 4 (clarification)</td><td>Step 5 (formulation)</td></tr>
<tr><td>Læring: læringsstiler, utviklingssoner, sosiokulturell teori, kognitiv teori, kan man planlegge læring?

Undervisning: læringsstiler, planlegging, tilrettelegging, interesser

Motivasjon: mestring, god/ond sirkel, interesse, indre/ytre faktorer, Maslow?</td><td>Læring

Undervisning

Motivasjon

Sosiokulturell teori

Kognitiv teori

Læringsstiler</td><td>Pedagogikk, læring

Undervisning</td></tr>
<tr><td>Step 6 (structure revision)</td><td>Step 7 (clarification revision)</td><td>Step 8 (formulation revision)</td></tr>
<tr><td>[Læring] utvikling, lek, fører til kunnskap

[Undervisning] didaktikk, klasseledelse, arbeidsformer

[Motivasjon] forutsetning for at læring skal skje, attribusjon</td><td>Maslows behovshierarki

Utvikling

Attribusjon</td><td>Læring</td></tr>
</table>

<table>
<tr><th colspan="3">The only PedNett Aloofer</th></tr>
<tr><td colspan="3">Work task used in informant session: The Comprehensive school task (work task facets in italics): Gjør rede for enhetsskolebegrepet og vurder hvordan dette står i sammenheng med begrepene likhet, likeverd og inkludering. Drøft hvordan du som lærer vil legge til rette for en inkluderende opplæring i en flerkulturell skole.</td></tr>
<tr><td colspan="3">Step 1 (selection) Rede for, Enhetsskolebegrepet, Vurder, Sammenheng, Likhet, Likeverd, Inkludering, Drøft, Lærer, Inkluderende opplæring, Flerkulturell skole</td></tr>
<tr><td colspan="3">Step 2 (brainstorming)
Definisjon enhetsskolebegrepet
Historikk før og etter 1920
Skille begrepene likhet, likeverd og inkludering
Hvordan stiller enhetsskolen seg ift. dette?
Inkluderende opplæring
- alle bli sett, føle tilhørighet
- bli kjent med kulturer i klasserommet, evt. religion – toleranse
- annerledes er ikke rart
Likeverd
Inkludering så langt det er mulig
Målet med enhetsskolen
Segregerte vs. integrerte løsninger</td></tr>
<tr><td>Step 3 (structuring)</td><td>Step 4 (clarification)</td><td>Step 5 (formulation)</td></tr>
<tr><td>Rede for: definisjon

Enhetsskolebegrepet: definisjon, historikk

Vurder: skille begrepene, målet med enhetsskole

Sammenheng: sammenligne begrepene

Likhet: segregerte vs. integrerte

Likeverd: segregerte vs. integrerte

Inkludering: segregerte vs. integrerte

Drøft: annerledes er ikke rart

Lærer: annerledes er ikke rart, ansvar for å utvikle holdninger

Inkluderende opplæring: alle</td><td>Definisjoner/forståelse av begrepene likhet, likeverd, (inkludering)

Dette er begreper som henger nært sammen, men som likevel har ulik betydning

Hvordan bli sett? Føle tilhørighet? Flere momenter enn de jeg kan tenke meg ...

Definisjon enhetsskolebegrepet

Historikk på noen områder innen enhetsskolens utvikling</td><td>www.google.com
www.wikipedia.no/com

Continues on next page:</td></tr>
</table>

bli sett, føle tilhørighet, så langt det er mulig Flerkulturell skole: alle bli sett, føle tilhørighet, bli kjent med ulike kulturer/religioner, toleranse		
Step 6 (structure revision)	Step 7 (clarification revision)	Step 8 (formulation revision)
[Vurder: skille begrepene] <ringet inn og tilføyd utropstegn> [Sammenheng: sammenligne begrepene] se spesielt på sammenhenger/forskjeller på likhet/likeverd, viktig å skille dem fra hverandre! [Flerkulturell skole: bli kjent med ulike kulturer/religioner, toleranse] føre til mobbing	[Likhet, likeverd] skille mellom disse [Føle tilhørighet] hva vil det si? [Definisjon enhetsskolebegrepet] finne dette et sted Toleranse – kan føre til mobbing. Spesielt viktig å opparbeide i et flerkulturelt klasserom.	Søke mer spesifikt på begreper. Hovedbegreper, og finne andre begreper innen samme kategori under dette hvis mulig.

<table>
<tr><td colspan="3">An example of a PedNett Rejecter
Demonstrated by one out of 2 Rejecter informants</td></tr>
<tr><td colspan="3">Work task used in informant session: The Comprehensive school task (work task facets in italics): Gjør rede for enhetsskolebegrepet og vurder hvordan dette står i sammenheng med begrepene likhet, likeverd og inkludering. Drøft hvordan du som lærer vil legge til rette for en inkluderende opplæring i en flerkulturell skole.</td></tr>
<tr><td colspan="3">Step 1 (selection) Enhetsskolebegrepet, Likhet, Likeverd, Inkludering</td></tr>
<tr><td colspan="3">Step 2 (brainstorming)
Historikk ift. enhetsskolen
Den flerkulturelle skolen
Betydningen av begrepene likhet, likeverd og inkludering
Kulturforståelse og tilpasning (religion?)
Språk
TPO</td></tr>
<tr><td>Step 3 (structuring)</td><td>Step 4 (clarification)</td><td>Step 5 (formulation)</td></tr>
<tr><td>Enhetsskolebegrepet: historikk, presentasjon av begrepet

Likhet: presentasjon av begrepet

Likeverd: presentasjon av begrepet, kulturforståelse og religion

Inkludering: den flerkulturelle skolen, presentasjon av begrepet, språk, TPO</td><td>Historikk om enhetsskolen

Presentasjon/definisjon av begrepene likhet, likeverd og inkludering (kanskje spesielt ift. hva LK06 sier om det?)</td><td>Enhetsskolen

Definisjon likhet skole

Definisjon likeverd skole

Definisjon inkludering skole</td></tr>
<tr><td>Step 6 (structure revision)</td><td>Step 7 (clarification revision)</td><td>Step 8 (formulation revision)</td></tr>
<tr><td>[Enhetsskolebegrepet: historikk, presentasjon av begrepet] OK

[Likhet: presentasjon av begrepet] OK, likhet og likeverd forveksles ofte

[Likeverd: presentasjon av begrepet] OK, [kulturforståelse og religion] OK, likhet og likeverd forveksles ofte

[Inkludering: den</td><td>[Historikk om enhetsskolen] <strøket ut>

[Presentasjon/definisjon av begrepene likhet, likeverd og inkludering] <strøket ut>

[(kanskje spesielt ift. hva LK06 sier om det?)] kommer ikke så tydelig fram på PedNett-sidene. Slå opp i LK06 eventuelt?</td><td>Fagbøker: Bruke LK06 til å slå opp hva den sier om likhet, likeverd og inkludering i skolen.

Continues on next page:</td></tr>
</table>

flerkulturelle skolen] OK, [presentasjon av begrepet] OK, [språk] OK, [TPO] OK		

Appendix 26 Examples of entries in a terminological tool compiled as a wiki

The terminological tools initiated by the Language Council of Norway demonstrate examples of term-wikis, cf. section 5.6.1, and http://www.termwiki.sprakradet.no./wiki/Hovedside. Below are listed the entries for *antivirusprogramvare* 'antivirus software', *hjemmeside* 'home page', and *sosialt medium* 'social medium'. (*Bokmål* and *Nynorsk* refers to the two standards for written Norwegian).

Antivirusprogramvare

BOKMÅL	
anbefalt/tilrådd term	antivirusprogramvare
kortform	antivirusprogram
godkjent	SR-MAA 18.9.2013
NYNORSK	
anbefalt/tilrådd term	antivirusprogramvare
kortform	antivirusprogram
godkjent	SR-MAA 18.9.2013
ENGELSK	
anbefalt/tilrådd term	antivirus software
synonym term	antivirus program
INFORMASJON	
definisjon	program på en datamaskin som forsøker å identifisere, motarbeide og fjerne datavirus og liknende skadevare
referanse	Språkrådets datatermgruppe
bruksområde	IKT
ansvarlig/ansvarleg	Språkrådets datatermgruppe
inndato	18.9.2013

Hjemmeside

BOKMÅL	
anbefalt/tilrådd term	hjemmeside
synonym term	hovedside
godkjent	SR-MAA 6.1.2014
NYNORSK	
anbefalt/tilrådd term	heimeside
kortform	hovudside
godkjent	SR-MAA 6.1.2014
ENGELSK	
anbefalt/tilrådd term	home page
INFORMASJON	
definisjon	nettside som fungerer som forside for et nettsted
referanse	Språkrådets datatermgruppe
bruksområde	6.1.2014
ansvarlig/ansvarleg	Språkrådets datatermgruppe
inndato	

Sosialt medium

BOKMÅL	
anbefalt/tilrådd term	sosialt medium
godkjent	SR-MAA 8.7.2011
NYNORSK	
anbefalt/tilrådd term	sosialt medium
godkjent	SR-MAA 8.7.2011
ENGELSK	
anbefalt/tilrådd term	social medium
INFORMASJON	
definisjon	system på vebben som tillater kommunikasjon eller samhandling mellom to eller flere personer
referanse	Språkrådets datatermgruppe
kommentar	Forekommer oftest som fellesbetegnelse i flertall: sosiale medier (nynorsk: sosiale medium, engelsk: social media). Noen systemer er åpne i den forstand at ethvert medlem kan ta initiativet til en diskusjon om et tema (diskusjonslister med e-post). I andre systemer bestemmes tema av en eier, mens andre deltakere kan kommentere (blogger). Enkelte systemer karakteriseres som nettsamfunn og er som regel åpne for alle (for eksempel Facebook, Twitter, LinkedIn). Innenfor nettsamfunnene kan medlemmene danne venne- og interessegrupper. Sosiale medier er en videreføring eller presisering av web 2.0, som er en populærbetegnelse på ulike typer ny funksjonalitet i vebben med deltakerdrevne interaktive tjenester.
bruksområde	IKT
ansvarlig/ansvarleg	Språkrådets datatermgruppe
inndato	8.7.2011

Glossary

This is a combined glossary and index, reproducing definitions or explanations which have been presented in the thesis, adding section numbers for further reading.

activation of conceptual knowledge [when students elaborate information needs as a part of their work tasks, chunks of conceptual knowledge are activated; relevant frame knowledge is actualized and contextualized; 2.4]

actor [information actors 1.3.1; information consumers 1.3.1; 5.3]

adjusting (prefocus formulation behaviour) [using PedNett in steps 6, 7 and/or 8 to adjust the form of self-produced terms from previous steps; 4.5.10]

Aloofer (PedNett user type) [the PedNett Aloofer visits the PedNett database, but is aloof to applying terms; makes only slight changes in step 6 and/or 7; 4.2.3; 4.6.3]

anchoring (Blair) [characterizes searchers' tendency to keep to their original expressed search queries – once an answer to a question is on the scene, people seem to use this answer as a reference point and select their own judgments only by making adjustments to this *anchor*; 2.5.4.2; resemblance to fastening 4.5.7]

Applicator (PedNett user type) [the PedNett Applicator selects PedNett terms in step 8 for the revised set of tentative search terms; 4.2.1; 4.6.1]

approaches to meaning [conceptualistic approach 2.3-4; 2.6; language-internal approach 2.3.2]

ASSIST learning style test (Diseth) [theory of method 3.4.1.2; shortcomings 3.4.4; analysis 4.3.1]

Blair (anchoring) [searchers' tendency to keep to their original expressed search queries; 2.5.4.2]

Borlund (simulated work tasks) ['cover stories' of work tasks used in data collection; 3.4.1.1]

bottom-up [approach to semantics, i.e. linguistic expressions are constituted as units via abstractions of actual usage events; 1.2.2; 3.1; 2.3.3; 2.5.1]

brain/mind distinction [in cognitive linguistics/psychology; 2.5.1]

brainstorming (terminological step 2 in the Revealment study) [in step 2 the informants were asked to perform a two-minute unstructured brainstorm of topics that they would want to include in an assignment; 3.4.2.2]

Byström (work tasks) [Byström's work task concept is applied by Borlund in association with her notion of simulated work tasks; 3.4.1.1]

Chomsky [the language-internal approach to meaning; the generative lexicon; 2.3.2-3]

clarification (terminological step 4 in the Revealment study) [step 4 was aimed at a clarification of the information need, in that the informants were asked for which topics (from the structured brainstorm) that they would need to find more information to be able to proceed with the work task; 3.4.2.2]

clarification revision (terminological step 7 in the Revealment study) [in step 7 the informants were instructed to enter PedNett and to consider revisions of the information need clarification (step 4); 3.4.2.2]

closure stage [stage 6 in Kuhlthau ISP model; cf. 1) task *initiation*, 2) topic *selection*, 3) prefocus *exploration*, 4) focus *formulation*, 5) information *collection*, and 6) search *closure*; 2.2.1]

co-creation [concerns how today's customers are actors, not consumers in the relationship between the customers, the companies, and their products; 1.3.1]

cognition [cognitive linguistics and cognitive psychology are both concerned with cognition; these theoretical frameworks both assume that humans in their interaction with the world mediate their experiences through informational structures in the mind; 2.3.3]

cognitive [refers to the mental representation and activation of knowledge in the user (and in this thesis specifically related to this cognitive process during information need elaboration); 1.3.4]

cognitive information searching [as opposed to collaborative information searching dealing with the social perspective; 1.3.1; 1.3.4]

cognitive linguistics [a theory which understands the linguistic capacity as an integrated part of our general cognitive abilities – applies a conceptualistic approach to meaning; 2.3-4]

cognitive psychology [theoretical framework concerned with cognition – assumes that humans mediate their experiences through informational structures in the mind during their interaction with the world – in this thesis used together with cognitive psychology; 1.3.3; 2.5]

cognitive user revealment [the cognitive process and resulting state of students in their elaboration and formulating of information needs throughout the search process, cf. also *user revealment*; 1.2.1]

collection stage [stage 5 in Kuhlthau ISP model; cf. 1) task *initiation*, 2) topic *selection*, 3) prefocus *exploration*, 4) focus *formulation*, 5) information *collection*, and 6) search *closure*; 2.2.1]

Combiner (PedNett user type) [the Term Combiner both reactivates terms from steps 1-4 as well as applies PedNett terms in step 8; 4.2.2; 4.6.2]

compromised need (Taylor) [the fourth level of expression of an information need, i.e. the question as presented to the information system; 1.2.3]

concept [word meaning, as opposed to *term* which refers to the formal expression of a word; 1.7; 2.3.2]

conceptual frame [the amount of conceptual knowledge making up the context of a word; a frame cuts out a chunk of conceptual knowledge which is relevant for the interpretation of language use in a given situation; 2.3.1]

conceptual knowledge [the meanings of words are made up by their relationships to conceptual knowledge, i.e. knowledge about *words* integrated with knowledge about the *world*; we call this frame knowledge; 2.3-4; vs. information and meaning 2.6]

conceptualistic approach to meaning [the meaning of an expression is equated with a conceptualization in the mind of a language user; cognitive linguistics is based on a conceptualistic approach to meaning; 2.3-4; 2.6]

conscious need (Taylor) [the second level of expression of an information need, i.e. the conscious, within-brain description of the need; 1.2.3]

constructivist approach to learning [the students are involved in an active process of meaning and knowledge construction during their information-based work tasks (instead of passively receiving information), a process which is aimed at a deep understanding of the topic under study; 2.2.1-3]

context [in this project used to refer to the linguistic context of words, in two respects – the *mental* context, i.e. the conceptual knowledge associated with a given word, and the context of *use*, e.g., how a word is used in the context of a work task; 1.3.4]

continuum [many phenomena in cognitive linguistic theory evolve along a continuum/a scale; linguistic categories often have fuzzy borders; 1.2.3; 1.3.2; 2.3.2; 2.3.3]

decay [the weakening of memories as a function of time - the memories may still be intact, but hard to retrieve due to lack of retrieval cues; decay is one of three basic causes of forgetting (the other two being *retrieval-cue failure* and *interference*); 2.5.4.2]

deep learning style [a student with a *deep* approach to learning is motivated by an interest in a given topical area and vocational relevance, and has an intention of acquiring a thorough understanding of the learning material; the *deep* approach is associated with the learning strategies 'use of evidence' and 'relating of ideas'; 3.4.1.2; 3.4.4]

dictionary view of the mental lexion [a word is defined by 'necessary and sufficient conditions' to separate it from other words; it is also structurally defined as its semantic relationships to other words; the dictionary view is opposed to a conceptualistic approach to meaning (in which words are made up by their relationships to conceptual knowledge); 2.3.2]

Diseth [he has translated and validated a Norwegian abridged version of the *Approaches and Study Skills Inventory for Students* (ASSIST) learning style test; 3.4.1.2; 3.4.4]

disintermediation [the situation when the information middlemen – librarians – are removed from the search process; opposed to mediated information retrieval (with the library user helped by a librarian); 1.3.1]

effect approach to information (Wersig) [information defined as the reduction of uncertainty; 2.6]

embedded information (Bates) [is found in artefacts created by the actions of animals and people in the world, past and present; 2.6]

embedded information needs [in the inquiry learning process a search task is embedded in an information search process, again embedded in a work task; 2.2 esp. 2.2.3]

embedded (as used in cognitive linguistics) [language is seen as embedded in the overall human cognitive abilities; 2.3.1.3; 2.3.3]

embodied cognition [the idea that the properties of certain categories are a consequence of the nature of human biological capacities and of the experience of functioning in a physical and social environment; 2.4.2; 2.6]

embodied information (Bates) [information in *experience*, in *actions* in the world, and in communicatory *expression*; this neural-cultural information is encoded in the brain and nervous system; 2.6]

emergent information [information is the pattern of organization of matter and energy, and these patterns may be characterized as *emergent*, meaning that the sum of the elements constitutes something new, a whole with its own distinct qualities; linguistic meaning emerges in the context of usage events (called emergentism); 2.6]

Enricher (PedNett user type) [the Structure Enricher enriches the structure in step 6 with a few PedNett terms; 4.2.4; 4.6.4]

entrenchment [is associated with frequency of use; a word is entrenched as part of a persons' conceptual knowledge by repeated use, and the unit decays if it is not exploited; 1.3.2; 2.1; 2.3.3]

exosomatic information (Bates) [information stored externally to the body of animals, which is a type of information that is core to the interests of information science; exosomatic information is found as embedded information and recorded information (cf. these); 2.6]

expert vs. novice [definitions used in this thesis – *expert*: university college teacher holding a master or PhD degree in either pedagogy or special pedagogy; *novice*: a second year educational science student; 2.3.3; 2.4.1-2; 2.5.2; 3.2.3; 3.5]

exploration stage [stage 3 in Kuhlthau ISP model; cf. 1) task *initiation*, 2) topic *selection*, 3) prefocus *exploration*, 4) focus *formulation*, 5) information *collection*, and 6) search *closure*; 2.2.1]

facet-embracing (prefocus formulation behaviour) [selecting extra many terms in step 1, not only typical work task facets; 4.5.1]

facet-trusting (prefocus formulation behaviour) [sticking to the work task facet terms (selected in step 1) in step 4 (clarification of information need) and onto step 5, cf. section 4.5.3]

fastening (prefocus formulation behaviour) [adding PedNett terms in steps 6 and 7, but sticking to original terms from steps 1-5 in step 8 (i.e. adding no new PedNett-terms in step 8); 4.5.7]

Fillmore [the originator of frame semantics within cognitive linguistics; 2.3.1]

final-patching (prefocus formulation behaviour) [behaviour exhibited by informants ending up with only one tentative search term in step 8 (which is not fetched from PedNett), though the informant might have used a rich self-produced vocabulary in steps 3 (structuring) and 6 (structure revision), covering several work task facets and their associations; 4.5.8]

first-patching (prefocus formulation behaviour) [using only one tentative search term in step 5, even though several other terms have been used to represent the work task and information need in step 3 and 4, cf. section 4.5.5]

forgetting of memories [according to cognitive psychological research, there are three basic causes of forgetting; decay, retrieval-cue failure, and interference; the opposite of forgetting is the retention of memories; 2.5.4.2]

formalized need (Taylor) [the third level of expression of an information need, i.e. the formal statement of the need 1.2.3]

formulation (terminological step 5 in the Revealment study) [in step 5 the informants were asked to write down exactly how they would formulate a search, with terms, and – if desired – operators/signs; 3.4.2.2]

formulation revision (terminological step 8 in the Revealment study) [in step 8 the informants were instructed to enter PedNett and to consider revisions of the formulation of tentative search terms (step 5); 3.4.2.2]

formulation stage [stage 4 in Kuhlthau ISP model; cf. 1) task *initiation*, 2) topic *selection*, 3) prefocus *exploration*, 4) focus *formulation*, 5) information *collection*, and 6) search *closure*; 2.2.1]

frame [the amount of conceptual knowledge making up the context of a word; a frame cuts out a chunk of conceptual knowledge which is relevant for the interpretation of language use in a given situation; 2.3.1]

frame semantics [a model for the representation of conceptual knowledge, based on a conceptualistic approach to meaning; frame semantics is associated with Fillmore; 2.3.1]

generative lexicon (Chomsky) [the language-internal approach to meaning 2.3.2]

Guided Inquiry model (Kuhlthau, Maniotes & Caspari) [model of the information search process based on inquiry learning 2.2.2]

information (vs. knowledge and meaning) [meaning and information is integrated in the concept of knowledge:

knowledge is information given meaning and integrated with other contents of understanding; 2.6]

information-based work task [the kind of work tasks in which the user is faced with information needs, typically student assignments; 1.1]

information behaviour (Wilson) [nested model of the information behaviour research area, as three circles embedded in each other – information behaviour, information seeking behaviour, and information search behaviour; 1.3.1]

information literacy [the competencies to recognize information needs and to locate, evaluate, apply and create information within cultural and social contexts; 1.1; 2.2]

information need [four levels of expression of an information need (i.e. the visceral, the conscious, the formalized, and the compromised need), cf. Taylor in 1.2.3; the motivation people think and feel to seek information, information search involving user interaction with an information system, cf. Cole, in 2.4.3]

information need elaboration vs. formulation [in the expression 'elaboration and formulation of information needs', the *formulation* part is the linguistic expression which is an integral part of a cognitive *elaboration* process; 1.2; 1.3.2]

information retrieval [is concerned with the computer end of the human-computer interaction; as opposed to information *searching* which is more concerned with the human end; 1.3.1]

Information Search Process model (Kuhlthau) [contains six stages, 1) task *initiation*, 2) topic *selection*, 3) prefocus *exploration*, 4) focus *formulation*, 5) information *collection*, and 6) search *closure*; 2.2.1]

information searching [is concerned with the human end of the human-computer interaction, as opposed to information *retrieval* which is more concerned with the computer end; cf. also information *searching* as opposed to information *seeking*: cf. Wilson's nested model 1.3.1; models of the information search process 2.2]

information seeking [any methods people employ to gain access to information, not just searching databased information – cf. Wilson's nested model of the information behaviour research area, as three circles embedded in each other – information behaviour, information seeking behaviour, and information search behaviour; 1.3.1]

initiation stage [stage 1 in Kuhlthau ISP model; cf. 1) task *initiation*, 2) topic *selection*, 3) prefocus *exploration*, 4) focus *formulation*, 5) information *collection*, and 6) search *closure*; 2.2.1]

input interference [the learning of something new can cause forgetting of something previously learned, cf. also *interference* 2.5.4.2]

interference [a phenomenon involved both in the learning of something new (input interference) and in retrieval of memories (output interference); the learning of something new can cause forgetting of something previously learned; in the retrieval of memories (a situation which is relevant for the information need formulation process) – when users activate their memory to come up with search term candidates – output interference refers to the situation when the recall of selected memory units interferes with the retrieval of those memory units which selected memory units was stored together with; interference is one of three basic causes of forgetting (the other two being *retrieval-cue failure* and *decay*); 2.5.4.2]

intermediary [the middleman in a *mediated* information search situation, typically a librarian or another kind of information professional; mediated searching is opposed to disintermediated searching, when the middleman is removed from the search process, as in the typical situation for the Google generation; 1.2.1]

Kahneman [how to avoid the anchoring effect 2.5.4.2; law of small numbers 3.4.4]

knowledge [representation and activation of conceptual knowledge 2.3-4; knowledge vs. information and meaning: meaning and information is integrated in the concept of knowledge: knowledge is information given meaning and integrated with other contents of understanding; 2.6]

Kuhlthau [Information Search Process model; contains six stages, 1) task initiation, 2) topic selection, 3) prefocus exploration, 4) focus formulation, 5) information collection, and 6) search closure; 2.2.1]

Kuhlthau, Maniotes & Caspari [Guided Inquiry model; based on inquiry learning 2.2.2]

label effect (Ingwersen) [characterizes searchers' tendency to express their information needs too generally or unilaterally; 2.5.4.2]

Langacker [considered to be one of the originators of the cognitive linguistic enterprise (together with Lakoff and Talmy); most importantly, language is seen as embedded in the overall human cognitive abilities; 2.3-4]

language (mental versus social perspective) [cognitive and generative linguistics study language as a mental phenomenon, with a focus on the representation of meaning; discourse analysis and social linguistics study language as a social phenomenon; 2.3.3]

language-internal approach to meaning [meaning is studied in terms of relations between expressions within a language; associated with Chomsky and the generative paradigm within linguistics; 2.3.2]

law of small numbers (Kahneman) [concerns how extreme results are more likely in small data sets; 3.4.4]

learning style test [a learning style can be understood as the conscious or unconscious ways students learn something new – how they concentrate, and the various ways they elaborate, acquire and remember new information; in the empirical study of the present project a Norwegian abridged version of the Approaches and Study Skills Inventory for Students (ASSIST) is applied; 3.4.1.2; 3.4.4]

lexicon and encyclopedy [conceptual knowledge about words vs. the world; in cognitive linguistics (e.g. the frame semantic model), the meanings of words are made up by their relationships to conceptual knowledge, i.e. knowledge about words integrated with knowledge about the world; common lexical semantics is based on a structuralistic view of the lexicon, in an environment with a clear distinction between the mental lexicon and encyclopedy; 2.3.2]

linguistic meaning [knowledge can be understood as information given meaning and integrated with other contents of understanding – it is thus a major concern how meaning is conceived in the theoretical framework applied; in this project a conceptualistic approach to linguistic meaning is applied (knowledge about words is integrated with knowledge about the world); other approaches mentioned are the language-internal approach (Chomsky), and the language-world approach (truth semantics); 2.3.2]

linguistic sign [cf. Saussure, the linguistic sign is composed of form (the linguistic expression) and content (the concept/meaning); 2.3.2]

Lykke (Nielsen) [her PhD (2002) is an example of the word association method applied in the field of information retrieval (in thesaurus development), to make retrieval systems more user-friendly by integrating vocabulary provided by topical experts; 3.3.1]

meaning [conceptualistic approach 2.3-4; language-internal approach 2.3.2; meaning potential 1.3.2; meaning vs. information and knowledge: meaning and information is integrated in the concept of knowledge: knowledge is information given meaning and integrated with other contents of understanding; 2.6]

mediated information retrieval [the traditional situation when the library user is helped by a librarian. Opposed to disintermediation, when the information middlemen – librarians – are removed from the search process; 1.3.1]

mental lexion [the word-store in the human mind; in the language-internal approach to meaning, each word is defined by the distance to other words in the structure; in the conceptualistic approach to meaning (used in this thesis), words are interpreted in relation to conceptual knowledge; 2.3.2]

mental perspective of language [language considered as a mental phenomenon (as in cognitive as well as generative linguistics) – opposed to a view of language as a social phenomenon (e.g., discourse analysis and social linguistics); in a mental perspective of language the question of a referent ('in the world') lies beyond the linguist's purview – the focus is on the mental lexicon and the structuralistic distinction between the form and content of the linguistic sign; 2.3.3]

mind/brain distinction [in cognitive linguistics/psychology; 2.5.1]

narrowing (prefocus formulation behaviour) [using more specific term(s) in step 5 than what was provided in the work task facet terms; 4.5.6]

neural network [neurons (in the brain) use elementary units or nodes that are connected together, each network has various structures called neural networks; cognitive psychology and cognitive linguistics share the connectionist perspective on neural networks, disregarding the 'brain as computer' metaphor, rather stating that language inheres in the dynamic processing of real neural networks; 2.5]

Nordlie [he introduced the concept of *user revealment* in his PhD (2000), in the interpretation of how the computer can reveal the users, i.e. uncover the information needs of the users; 1.2.1]

novice vs. expert [definitions used in this thesis – *novice*: a second year educational science student; *expert*: university college teacher holding a master or PhD degree in either pedagogy or special pedagogy; 2.3.3; 2.4.1-2; 2.5.2; 3.2.3; 3.5]

output interference [refers to the situation when the recall of selected memory units interferes with the retrieval of those memory units which selected memory units was stored together with, cf. also *interference* 2.5.4.2]

Pappas & Tepe (cf. Pathways to Knowledge model)

Pathways to Knowledge model (Pappas & Tepe) [model of the information search process based on inquiry learning 2.2.3]

patterns in the empirical data [meaningful structures or themes found between variables in the data; topics to be subject for further analysis; figure 4.2 in section 4.10 displays patterns found in the analysis, cf. also 3.1.2; 4.7-10]

PedNett cluster [refers to a PedNett entry term, plus the sum of its associated words and their relationship descriptions; 2.3.1.2; 3.3.2.4; 3.3.4-5]

PedNett user type [six labels: PedNett *Applicator*, Term *Combiner*, Term *Reactivator*, Structure *Enricher*, PedNett *Aloofer*, and PedNett *Rejecter*; 4.2-6]

phrasing (prefocus formulation behaviour) [working at phrase or sentence level rather than at word level 4.5.2]

Prearrangement study [the first part of the empirical study in this project; concerns the tool, i.e. the PedNett database made from teachers' word associations and relationship descriptions – collectively referred to as associative data 3.3]

prefocus stage [a stage in the information search process in which the users struggle in finding a focus, early on in their work tasks; they experience feelings of confusion, frustration, and doubt, and have vague information needs; if the prefocus stage involves searching, it is of an exploratory nature; cf. 1.1-3; models of the information searchprocess 2.2; Cole's theory of information needs (prefocus, focusing, and post-focus stage) 2.4.3]

query formulation [the search question as presented to the information system (i.e. the compromised need, the fourth level of expression of an information need in Taylor's terminology); in the literature query formulation is also referred to as request formulation or search formulation 1.2.3]

principle of uncertainty [stated by Kuhlthau in her *Information Search Process model*; uncertainty is a cognitive state that commonly causes affective symptoms of anxiety and lack of confidence; uncertainty and anxiety can be expected in the early stages of the information search process; the affective symptoms of uncertainty, confusion, and frustration are associated with vague, unclear thoughts about a topic or question; 2.2.1]

process approach to learning [models of the information search process; 2.2]

Reactivator (PedNett user type) [the Term Reactivator reactivates terms from steps 1-4 (work task facets or self-produced) and uses them in step 8 for the revised set of tentative search terms; 4.2.3; 4.6.3]

recall [in this thesis recall is used in the sense fetched from the topical area of psychology – dealing with the retrieval of stored memory - not in the sense found in information retrieval (as recall versus precision during searching); 2.5 esp. 2.5.2]

recognition [recognition occurs if a person is confronted with some kind of stimulus matching the memory content; it is easier to *recognize* some information which is needed in a situation rather than to *recall* the same information from memory; 2.3.1; 2.5.2]

recorded information (Bates) [communicatory or memorial information preserved in a durable medium, created by the use of symbols which is primary to human beings; 2.6]

reduction of uncertainty [refers tp Wersig's effect approach to information; 2.6]

Rejecter (PedNett user type) [the PedNett Rejecter visits the PedNett database, but does not use any of the terms for revision of steps 6-8; cf. 4.2.3; 4.6.3]

removing (prefocus formulation behaviour) [behaviour exhibited by informants in the course of using PedNett in steps 6, 7 and 8, when they remove one or several self-produced terms from previous steps; 4.5.9]

representation of conceptual knowledge [conceptual knowledge is dynamic in the sense that it is in continuous change when information is added, repeated or adjusted, as each individual continually abstracts information from experience with the surrounding world through the senses, speech, and reflection; in this thesis a frame semantic model of the represenation of conceptual knowledge is applied (Fillmore) 2.3-4]

request formulation [the search question as presented to the information system (i.e. the compromised need, the fourth level of expression of an information need in Taylor's terminology); in the literature request formulation is also referred to as query formulation or search formulation 1.2.3; 2.5.4.2]

retention of memories [how conceptual knowledge is kept/stored in memory; as opposed to forgetting of memory; 2.5.4.2]

retrieval (of stored memories, as used in psychology) [getting memories back, as in the retrieval of memory; in this thesis we are concerned with recognition versus recall in the retrieval process: recognition provides more retrieval cues, therefore it is easier to recognize something that has been encountered before than to recall it; 2.5.2]

retrieval (vs. searching and seeking) [information retrieval is concerned with the computer end of the human-computer interaction; as opposed to information *searching* which is more concerned with the human end, and information *seeking* which includes any methods people employ to gain access to information resources (such as browsing, observing, reading, and consulting friends); 1.3.1]

retrieval-cue failure [the kind of forgetting that asserts that people lose access to memories because they lose access to the cues that can retrieve them; the memories are kept in long-term storage, but one is unable to locate them; retrieval-cue failure is one of three basic causes of forgetting (the other two being *decay* and *interference*); 2.5.4.2]

revealment ['the act of revealing', i.e. to make something known or to disclose something, as in 'to reveal a secret'. Used in *user revealment* to refer to the cognitive process and resulting state of students in their elaboration and formulation of information needs throughout the search process; 1.2.1]

Revealment study [the second part of the empirical study in this project; concerns the users, i.e. the students and their revealment process; 3.4; ch. 4-6]

search formulation [the search question as presented to the information system (i.e. the compromised need, the fourth level of expression of an information need in Taylor's terminology); in the literature search formulation is also referred to as request formulation or query formulation 1.2.3]

searcher [a person who searches for information using an information system; 1.2.1]

selection (terminological step 1 in the Revealment study) [in step 1 the informants were instructed to encircle what they conceived of as the work task facet terms; 3.4.2.2]

selection stage [stage 2 in Kuhlthau ISP model; cf. 1) task *initiation*, 2) topic *selection*, 3) prefocus *exploration*, 4) focus *formulation*, 5) information *collection*, and 6) search *closure*; 2.2.1]

self-production (prefocus formulation behaviour) [adding self-produced terms in step 5, with little or no use of the work task facet terms, or in addition to these; 4.5.4]

semantic barrier [introduced by Svenonius in association with human-computer interaction; in this thesis used to refer to the cognitive challenge of expressing a knowledge gap; the *semantic barrier* (cf. section 1.2.3 and Svenonius 2000) in information searching is the challenge faced by searchers who are in a state of uncertainty, driven by a desire to *seek meaning* (cf. section 2.2.1 and Kuhlthau 2004), when they strive to select information, attribute meaning, and integrate this as new knowledge in their current body of conceptual knowledge; 1.2.3; 2.6]

simulated work task [a simulated work task situation is a short 'cover story' which describes a situation that may lead to IR and seeking; the 'cover story' is a semantically rather open description of the scenario and context of a given simulated work task situation; 3.4.1.1]

social perspective of language [a view of language as a *social* phenomenon like, e.g., in James Paul Gee's (2011) discourse analysis and social linguistics; 2.3.3]

strategic learning style [the *strategic* learning style is associated with the intention of achieving the best results possible; 3.4.1.2; 3.4.4]

structure revision (terminological step 6 in the Revealment study) [in step 6 the informants were instructed to enter PedNett and to consider revisions of the structured brainstorm (step 3); 3.4.2.2]

structuring (terminological step 3 in the Revealment study) [in step 3 the informants were asked to structure the brainstorm according to the work task facet terms selected in the first step; 3.4.2.2]

surface learning style [a student with a *surface* approach has a predominant motivation of fear of failure and is concerned with the completion of a course; s/he is preoccupied with an intention of reproducing rather than understanding; the *surface* approach is associated with 'rote learning'; 3.4.1.2; 3.4.4]

Svenonius [she introduces the concept of a semantic barrier in association with human-computer interaction; in this thesis *semantic barrier* is used to refer to the cognitive challenge of expressing a knowledge gap; 1.2.3; 2.6; 1.2.3; 2.6]

system-driven user revealment [information needs of the users are revealed by the searching system, cf. also *user revealment*; 1.2.1]

Taylor [four levels of expression of an information need; 1.2.3]

term [the formal expression of a word, as opposed to *concept* which refers to word meaning; 1.7; 2.3.2]

terminological steps [data collection and trigger activity used in the Revealment study; 3.4.2.2]

terminology [refers to linguistic expressions in a topical area as, e.g., pedagogic terminology; as opposed to *vocabulary* which refers to individuals' mentally stored words – as in 'the teachers' vocabulary', or a stock of words used in a as a whole in a given context, e.g., 'the lead-in vocabulary of a searching thesaurus'; 1.7]

tip-of-the tongue state [i.e. T.O.T.; people in the T.O.T. state often know correctly that the word is somewhere in their vocabulary, they often correctly remember what letter the word begins with, how many syllables it has, and approximately what it sounds like; sometimes this 'feeling of knowing' something one at first is unable to recall, results in successful recall during a conversation in which related nodes to the hard-recalled item is activated: T.O.T. is a kind of retrieval block which can be produced by the winner-takes-all system; 2.5.4.1-2]

topical area [an area of topical knowledge; 1.1 footnote]

usage-based meaning [words are interpreted in relation to conceptual knowledge, which is derived from individual experiences of all kinds, acquired through our senses (vision, smell, touch, etc.); meaning is a property of utterances (Evans 2006), i.e. meaning emerges in the context of usage events; 2.3.2; 2.5.5]

user [user of an information system. In this thesis the users under investigation are students working on an assignment and facing terminological challenges prior to search onset; 1.2.1]

user revealment ['to make something known or to disclose something'; def. by Seland in this thesis, labelled *cognitive user revealment*: the cognitive process and resulting state of students in their elaboration and formulating of information needs throughout the search process; def. by Nordlie (2000), in the present thesis labelled *system-driven user revealment*: information needs of the users are revealed by the searching system, modelled by user-intermediary interaction; 1.2.1]

visceral need (Taylor) [the first level of expression of an information need, i.e. the actual, but unexpressed need for information; 1.2.3]

vocabulary [refers to individuals' mentally stored words – as in 'the teachers' vocabulary', or a stock of words used in a as a whole in a given context, e.g., 'the lead-in vocabulary of a searching thesaurus'; as opposed to *terminology* which is used for linguistic expressions in a topical area as, e.g., pedagogic terminology;1.7]

Wersig [effect approach to information; i.e. information defined as the reduction of uncertainty; 2.6]

Wilson [associated with the nested model of the information behaviour research area, as three circles embedded in each other – information behaviour, information seeking behaviour, and information search behaviour; 1.3.1]

winner-takes-all system [a process in which a stronger node inhibits weaker ones, so that the stronger node comes more and more to dominate the weaker nodes; one kind of retrieval block which can be produced by the winner-takes-all system, is the *tip-of-the tongue state*; 2.5.4.1]

word [refers to the compound of expression and meaning; 1.7; 2.3.3]

word association testing [a method originally used in psychology and psycholinguistics, based on the assumption that verbal associations can elicit the nature and structure of the mind, because associative processes are basic to the understanding of thinking 1.6; 3.3.1]

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How do students formulate their information needs in the early stage of their information-based work tasks? How can students benefit from their teachers' terminological competence? How do students' learning styles affect their formulation behaviour?

Elaborating information needs is a process of knowledge formation in which students have to activate their vocabulary and relate new ideas to their own current knowledge. This involves the handling of information which is not yet integrated as meaningful knowledge, due to the 'knowledge gap' actualized by the task requirements.

This thesis investigates whether – and how – students can benefit from experts' terminological understanding of a topical area, in the form of an associative semantic network used as an idea generator in the organization of work tasks. The research topic is explored with an interdisciplinary perspective, using information searching theory, cognitive linguistic theory, and cognitive psychological theory.

The outcome of the analysis shows that students benefit from using a semantic tool in the prefocus stage of their work tasks, as a trigger for the activation and enrichment of their own knowledge. This is especially true for students with a deep learning style, who exhibit an ability to formulate their work tasks with a rich vocabulary, also on their own. For a semantic tool to be useful in the prefocus stage, students have to acquire learning strategies characterized by a thoroughness in the way they approach the work task process. This includes terminological elaboration of their information needs prior to search system interaction.

A semantic tool of the kind piloted in this study should be available on the digital platforms students apply, and be used in bridging the gap between the students' own vocabulary and the terminology used in information available on the Web.

Activated current knowledge enhances students' abilities in information need formulation. This can be stimulated by the use of associative semantic tools, as well as by an increased digital literacy among students.