Reflection Workshop Workbook

September 14-15, 2017
Seattle, WA
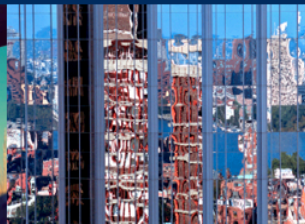
WELCOME

Welcome to the 2017 Workshop on Reflection in Engineering Education. We are delighted to be sharing this event with you. Over the next two days, we will work together to explore practical issues related to promoting engineering student reflection and build community among educators interested in reflection. We will also touch on supporting research addressing topics related to reflection in engineering education, and help participants prepare to support others address reflection in engineering education.

We've been working toward this workshop for a while. The specific planning started in late Spring of 2016, when we realized there was an opportunity to bring together those with notable interests in reflection. The workshop represents a culminating activity for the Consortium to Promote Reflection in Engineering Education (CPREE), funded by the Helmsley Charitable Trust. Our consortium activities created an unprecedented opportunity to consider reflection in engineering education from a broad perspective, and we are excited to share what we've learned with you. Finally, the workshop honors work on reflection done by various members of the engineering education and human centered design communities.

The workshop is organized into five parts: situating, connecting, creating, analyzing, and reflecting. We took seriously the idea of a workshop being about work, and in our case, the goal is to work together.

We have many people to acknowledge. We would like acknowledge Helmsley Charitable Trust for generously funding both CPREE and this workshop, and for believing in the power of a focus on reflection. We would like to acknowledge the work of the CPREE partner campuses and specifically the principal investigators of those campuses. We also would like acknowledge Inverness Research, evaluators on the grant, for their insightful perspective. Finally, we would like to thank everyone at CELT and HCDE who helped make this happen.

We hope you have a great time,
The Workshop Team

Jennifer Turns, Cindy Atman, Lesley Pfeifer, Terri Lovins,
Giovanna Scalone, Cheryl Allendoerfer, Kathryn Shroyer

CELT
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Workshop Schedule

Wednesday, September 13, 2017		
	5:00-7:00	Happy hour / Meet and greet
Thursday, September 14, 2017		
	8:00-8:30	Arriving
	8:30-9:15	Part 1: Situating
	9:15-10:00	Part 2a: Connecting with each other - Introductions
	10:00-10:15	Break
	10:15-11:15	Part 2b: Connecting with each other - Discussing your handouts
	11:15-12:00	Part 3: Creating activities
	12:00-1:00	Lunch
	1:00-1:30	Part 4a: Analyzing activities - Noticing the space
	1:30-3:15	Part 4b: Analyzing activities - Activity perspective
	3:15-3:30	Break
	3:30-5:15	Part 4c: Analyzing activities - Student perspectives
	5:15-6:00	Reflective happy hour
	6:00-9:00	Dinner
Friday, September 15, 2017		
	8:00-8:30	Arriving
	8:30-8:45	Day 2 welcome
	8:45-10:30	Part 4d: Analyzing activities - Educator perspectives
	10:30-10:45	Break
	10:45-11:15	Part 5a: Reflecting - Synthesis
	11:15-11:30	Part 5b: Reflecting - Letter to self
	11:30-12:00	Part 5c: Reflecting - Open conversation
	12:00-1:30	LUNCH

WORKSHOP GOALS
(Synthesized from attendee input)

Community (40%): Establishing and sustaining a professional community interested in reflection in engineering education for learning and teaching.
Practical Knowledge (40%): Engaging in conversations related to best practices for a shared understanding and practical ideas using reflection.
Scholarly Knowledge (10%): Supporting scholarly work on reflection in engineering education.
Preparing to Support Others (10%): Gaining insights about how to support others through community building and professional development.

Table of Contents

Part 1
Situating

Activity 1: What we will produce?

Key question: What will we produce as we work together over the next couple of days?

Instructions

- Think about the following mad lib:

    Together, we will create _____ to enable _____ to do _____.

- Working alone or in a group, complete the mad lib at least two times, recording your responses using white paper and large lettering (we recommend the large pens).

- Be prepared to share your results.

Personal reflection

Part 2
Connecting With Others

Activity 2a: Introductions using micro-task content

Key question: Who are we, and what are some of our thoughts about reflection?

Instructions
- Find a partner.
- With your partner:
    - Identify a micro-task that interests you and your partner, find the printout of the results of that micro-task, and review the results together.
    - Identify something you each find interesting or notable.
    - Be prepared to introduce each other and what you found interesting.

Supporting materials
- Micro-task 1a: Phrase completion (on table)
- Micro-task 1b: Bookshelf (on table)
- Micro-task 2, option 1: Noticing in the workshop questions (on table)
- Micro-task 2, option 2: Excited about / Most challenging (on table)
- Micro-task 2, option 3: Focusing on reflection can help with the following challenges (on table)

Note 1: These supporting materials are not included in this workbook in their entirety, but the next two pages include reminders of the original tasks.

Note 2: Micro-task 3: Shareable stories will not be used during this activity due to the amount of text, but will be made available on the tables following the activity.

Personal reflection

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Micro-task #1a: Phrase completion

Explanation/instructions: Conversations about reflection can get tricky when we treat reflection as a monolithic idea. One way to see variation is think about types of reflection (i.e., ___ reflection) and/or what reflective can modify (i.e., reflective ____). For example, we can speak of critical reflection or difficult reflection, and we can speak of reflective thinking and reflective design. What are some completions that help you? Please share your ideas on a slide below.

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Micro-task #1b: Reflection bookshelf

Explanation/instructions: Although it is not always clear, there is a lot reading material available (i.e., books, articles, websites) for someone who is interested in reflection. What is on your reflection bookshelf? What do you think would be good for us as a group to have on our collective reflection bookshelf? If this micro-task appeals to you, please share your ideas on a page of the following google slide deck:

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Micro-task #2: Considering the questions

Explanation/instructions: Consider the questions about reflection (attached as 2 pdfs in the Micro-task #2 email) that you, and other applicants, posed in your workshop applications. Complete one (or more) of the following:

- Option 1: **What do you notice?**
- Option 2: **Excited about / Most challenging in working on reflection**
- Option 3: **I think a focus on reflection could help the following challenges in engineering education...**

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Micro-task #3: Telling a shareable story

Explanation/instructions: This time we are interested in short shareable stories (roughly 150-200 words) about your experiences with reflection. We are suggesting two options:

- Option 1. A story about a personal experience with doing reflection.
- Option 2. A story about trying to help students reflect.

Activity 2b: Sharing of handouts

Key question: What types of reflection-related projects, activities, and/or interests do we all bring to this workshop, and how can we help each other along?

Instructions
- Form a working group with workshop participants who have similar interests (we will support this)
- In your working group:
  - Decide on a process of engaging with each other around your handouts.
  - Engage with each other around your handouts.
  - Prepare one or more quick observations to share with the whole group.

Supporting materials
- Your handouts

Note: Remember to visit the Handout Gallery (east wall) where attendee handouts are posted

Personal reflection

Part 3
Creating Activities

Activity 3: Create a reflection activity

Key question: What types of reflection activities might we consider doing with students?

Instructions
- Form a working group with 1-2 other workshop participants.
- In your group:
    - o Identify a teaching situation that is relevant to you.
    - o Create a reflection activity that you think would be appropriate.
    - o Prepare a description of your activity for sharing.
    - o Be prepared to share your activity with others.

Supporting materials
- Pens and paper

Personal reflection

Part 4
Analyzing Activities

Activity 4a: Analyzing activities – Noticing

Key question: What does the "space" of reflection activities look like?

Instructions
- Think about the activities that were presented earlier.
- At your table, discuss the following questions:
    - o What did you notice about how the activities differed from each other?
    - o What did you notice about how the activities were similar to each other?
    - o Consider using the "Reflection Activity Design/Adaptation Dimensions" as a resource for thinking about how the activities were different and/or the same.
    - o Be prepared to discuss at least one dimension of similarity or difference that was discussed at your table. Identify something you each find interesting or notable.

Supporting materials
- Reflection Activity Design/Adaptation Dimensions (in this workbook)

Personal reflection

Reflection Activity Design/Adaptation Dimensions

INFERRED ELEMENTS OF DESIGN	OBSERVED VARIATIONS
Who is reflecting?	- An individual student - Reciprocal pairs - A group/team - The whole class
How long does the activity take?	- One-two minutes - A short-medium assignment, e.g., an hour - An elaborate multi-phase project or portfolio - Multiple instances (short or medium in length) in a series over time
How is the reflection activity evaluated? How are students held accountable?	- Graded as an assignment - Points for doing it, but not graded - Checked as done, but no points or grade - No points, no grade
What is the mode of reflection?	- Writing, informal - Writing, formal - Oral presentation - Video/photo product - Combination of modes
What is the scope of the experience being reflected upon?	- One class session/lecture, or single concept - Reading assignment (or series) - Test or exam - One assignment (homework, lab) - Major course unit or project - Whole course - Experience(s) prior to the course
When does the reflection activity take place?	- In class - Out of class
Who facilitates the reflection activity?	- The instructor(s) - A neutral third party
Who sees the products of the reflection?	- Shared immediately in class (i.e., heard by other students) - Reviewed by the instructor(s) and debriefed anonymously with the class - Reviewed by the instructor(s) and given individual feedback

Source: Inverness Research, 2017 (CPREE Evaluators)

Activity 4b: Analyzing activities – Activity perspective

Key question: How might you characterize the reflection activity that you created, relative to the space of activities that could be created?

Instructions
- Working with the same group you were in when you created your reflection activity:

  - o Think about how you might describe your reflection activity.
  - o Think about how the activity you created might be situated among other reflection activities for engineering education.
  - o Consider using the supporting materials as a resource(s) in order to identify ways to characterize your reflection activity
  - o Be prepared to share your thoughts on characterizing your reflection activity.

Supporting materials
- Reflection activities: Four dimensions of variation: Part 1 – Definitions (in this workbook)
- Reflection activities: Four dimensions of variation: Part 2 – Redesign Challenges (in this workbook)
- Educational purposes for reflection activities (in this workbook)
- Categorizing 120 reflection activities: One take (in this workbook + in table envelope)
- Selected reflection activity cards (in table envelope, + full descriptions available at http://cpree.uw.edu)

Personal reflection

Reflection activities: Four dimensions of variation
Part 1 - Definitions

"Explicitness. The dimension of explicitness has to do with *the extent to which the reflection activity is explicitly represented to the learners as an instance of reflection*. A reflection activity that features high explicitness is one that is clearly labeled as reflection. A reflection activity that features low explicitness is one that is not called out to students as reflection. High explicitness can help a student see continuity among reflection activities and perhaps, over time, help students develop their own reflective practice. Low explicitness can be useful in instances where students have awkward associations with the notion of reflection or where the additional effort to name an activity as reflection gets in the way of the work of the activity."

"Customization. The dimension of customization has to do with *the extent to which an activity is adapted to the specific context of use*. A reflection activity that features high customization is one that is specific to the context, i.e., bespoke. For example, an activity may be carefully arranged to provoke reflection by creating a specific circumstance (e.g. de-familiarization or surprise). A reflection activity that features low customization is one that is generic. Low customization results in an activity that can be ported easily from one context to the next without a need to revise the activity because the activity features nothing specific to the context of use. Such activities are much more repeatable and reusable in a variety of contexts. These "low" customization activities seem to be less about creating a specific circumstance that provokes reflection and more about creating recurring opportunities to reflect."

"Guidance. The dimension of guidance has to do with *the extent to which the reflection activity provides support for a learner to be successful*. A reflection activity that features high guidance is one that provides extensive support for the learner so that he/she is succeeds in their engagement with reflection. A reflection activity that features low guidance provides little specific support for the learner in order to support successful engagement with reflection. Such activities rely on the learner's prior understanding of and ability to engage in reflection."

"Accountability. The dimension of accountability has to do with *the extent to which to the reflection performance is "counted."* A reflection activity that features low accountability is one for which students are not required to provide any evidence of the nature of the reflection. A reflection activity that features high accountability is one for which students are required to provide evidence of their engagement in the activity, and also receive a grade to account for their engagement. In our analysis, one activity was identified "
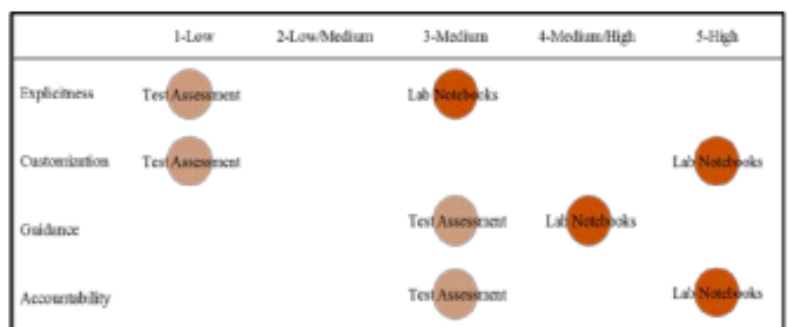
Figure 1 This illustrates how the dimensions of variation can be used collectively to create an activity profile. The lightly colored circles show the level of accountability, customization, explicitness and guidance for the reflection activity "Test Assessment" while the darker circles show the level of accountability, customization, explicitness and guidance for the reflection activity "Lab Notebooks."

Extracted from: Turns, J.A., Scalone, G., Arif, A., Lovins, T., & Atman, C. (2017). Dimensions in designing reflection activities. *In Proceeding of the World Engineering Education Forum 2017 Conference*, Kuala Lumpur, Malaysia, November 2017.

Reflection activities: Four dimensions of variation Part 2 – Redesign challenges

The four dimensions of variation can be used to think about how an activity could be redesigned. To support such thinking, the four dimensions of variation (i.e., accountability, guidance, customization, and explicitness) are represented below in the form of redesign challenges.

More Explicit	Less Explicit
In order to help ensure students see connections among reflection activities, it helps to have the reflection be more explicit. Challenge: Find ways to make the reflection component of the activity more explicit.	Sometimes, it may be a detriment if reflection is too explicit. Perhaps students have negative associations, or the activity is too cumbersome with the additional explicitness. Challenge: Find a way to make the reflection aspect of the activity less explicit.
More Customized	**Less Customized**
Customization, those features big and small that tie something to a local context, can increase success. Challenge: Find ways to add customization to the activity.	Customization, while helpful for a single instance, can make it difficult to see an activity as transferable to other situations, something helpful if we want students to develop a reflective practice. Challenge: Find ways to make the activity less custom, more generic.
More Guidance	**Less Guidance**
In order to help learners succeed, even achieve high levels of success, educators can scaffold or provide guidance. Challenge: Find one or more ways to additionally guide the learner toward success.	If activities provide too much guidance, learners may never be able to "do it on their own." By reducing the amount of guidance (like the metaphorical removing of training wheels), learners have a chance to go it alone. Challenge: Find ways to remove some of the guidance from the activity.
More Accountability	**Less Accountability**
When there is no accountability, learners may not engage in an activity. Accountability an increase engagement. Challenge: Find one or more ways to add accountability to the activity.	Too much accountability can weigh heavily an educational activity, interfering with intrinsic motivation, interfering with how a learner wants to go it alone. Less accountability lets a learner practice taking charge. Challenge: What might this activity look like with less accountability?

Adapted from: Turns, J.A., Scalone, G., Arif, A., Lovins, T., & Atman, C. (2017). Dimensions in designing reflection activities. *In Proceeding of the World Engineering Education Forum 2017 Conference*, Kuala Lumpur, Malaysia, November 2017.

Educational Purposes for Reflection Activities (A Typology)

Reflection activities can serve more than one purpose. Some reflection activity purposes focus on supporting student learning and growth (shown in lighter gray), while others may have a formative assessment purpose for educators (shown in darker gray).

supporting student learning and growth	1) To help students better understand the course content or skills.
	2) To help students better understand their own strengths and weaknesses as learners/students, including their ability to productively participate on a team.
	3) To help students understand how what they are learning may apply in the real world and in their future careers.
	4) To help students explore personal motivation and interests for studying engineering and developing an identity as engineer (or other subject they are studying and field they want to enter).
	5) To engage students in thinking about social justice, ethical, or cultural questions or topics related to STEM.
supporting formative assessment for educators	6) To help the instructor assess student learning/comprehension at a particular point during instruction.
	7) To help the instructor assess the extent to which a particular assignment (e.g., homework, a lab, a project) increases student understanding/achievement in order to improve the assignment.
	8) To help the instructor assess how well the overall course is working for students so as to make adjustments.

Source: Inverness Research, 2017 (CPREE Evaluators)

Categorizing 120 Reflection Activities: One take (part 1)

PROCESSING CONTENT / CONNECTING LEARNING

- Concept Maps: Connecting the Dots
- Reading Reflections in Physics
- Your Own Understanding
- What? So what? Now what?
- Reading Response
- Directed Reading of a Research Article
- Insta-Reflections as Reading Reflections
- Weekly Reflections and Connections
- Written Course Project
- Entropy, Revisited
- In-Class Problem Szets
- Process as a Path to Solutions
- Process Problem Assignments
- Journaling in Biology
- Online Course Community
- Mentoring Moments Through Portfolios: Connecting Students with Alumni
- Mock Interviews

Thanks to Frank Lee of Bellevue College for these reflection activity categories

POST-EXPERIENCE REFLECTION

- Class Project Reflections and Reflection Essays
- Reflection After Hands-On Activity
- Plant Tour Reflection
- Using the STAR Method to Debrief Past Experiences
- Balsa Wood Bridge Project
- Project Reflection
- Reflecting on Senior Capstone
- Course Wrap-up
- Metals 1.0: Art & Engineering
- Professional Experience Requirement
- Reflection in Engineering Education and Transformative Learning
- Biology Meets Computer Science: DNA Project
- Photo Documentation of Co-Curricular Involvement
- Major Assignment Reflection
- Reflection Writing Assignment

Thanks to Frank Lee of Bellevue College for these reflection activity categories

COURSE DELIVERY

- White Papers in Math
- Minute Papers: Strengths, Insights, and Improvement
- Minute Papers: Taking Stock of the Day
- Muddiest Points Reflections: Asking Students to Express Confusing Points from Class Instruction
- Minute Papers in Lab
- Two-minute Reflections
- Neon Notecards: Periodically Checking in with Students
- Feedback Survey
- Clicker Questions: Thinking About Your Learning
- Interactive Grading

COURSE CONTENT

- Understanding Environmental Problems through Chemistry
- Reflecting in Online Discussion Posts: Connecting Technical Content to the Broader Context
- To Fly or Not to Fly
- Ethical Decision Making in Engineering
- Using Model Predictions to Solve Challenges in a Team Design Project

Thanks to Frank Lee of Bellevue College for these reflection activity categories

Thanks to Frank Lee of Bellevue College for these reflection activity categories

Categorizing 120 Reflection Activities: One take (part 2)

COURSE ASSIGNMENTS

- Seeing the Forest: Linear Algebra Application Project
- Photo Scavenger Hunt
- Story Writing as a Tool for Enhancing Engineering Education
- Engineering concepts for a 4th grader
- Midterm Synthesis Reflection
- Client – Consultant Mathematics Project
- Developing Your Resume

Thanks to Frank Lee of Bellevue College for these reflection activity categories

EXAMINATIONS

- Exam Analysis
- Exam Wrappers: Reflecting on Study Skills
- Exam Wrapper: Reflecting on Exam Prep
- Exam Wrapper: Explaining Why
- Dual Survey Exam Wrappers
- Notecards: Reflecting on Quiz Preparedness and Performance
- Assessing Exam Preparedness
- Pre-Exam Exam
- Post Exam Reflection
- Math Test Reflection Essay
- YouTube Test Corrections
- Reflection Exam Question
- Earn Points Back – Test Assessment
- Partial Credit Requests
- Filling in the Gap
- Reflecting in Pre-Reading Quizzes
- Debriefing Weekly Quizzes

Thanks to Frank Lee of Bellevue College for these reflection activity categories

STUDY SKILLS

- Scheduling Your Student Life
- Homework Re-Dos: Reworking Problems and Explaining Errors
- Homework Time Upgrade
- Have You Made Good Choices Today?
- Reflecting on Your Felder's Learning Style Index
- Bootcamp: Daily Practice Problems
- Pain Poll: Understanding Engagement in Homework
- Taking the Time to Plan

Thanks to Frank Lee of Bellevue College for these reflection activity categories

PROCEDURAL

- Informal and Formal Design Reviews
- Professional Lab Notebooks: An Introductory Research Lab Course
- Learning From Notable Scientists' Field Notebooks
- Peer Feedback in a Research Laboratory Experience
- Weekly Status Reports: Individual Reflections Based on a Group Activity
- Calibrated Writing in Chemistry
- Senior Capstone Design: Weekly Sprint Reflection
- Peer Review of Presentations Using VoiceThread (VT)
- Peer and Self-Assessment Using a Skills-Development Rubric

Thanks to Frank Lee of Bellevue College for these reflection activity categories

Categorizing 120 Reflection Activities: One take (part 3)

TEAMS AND GROUPS

- Reflecting on Effective Teamwork
- Team Roles and Responsiblities
- Team Design: Skills Survey
- Teamwork and Lifelong Learning
- Socratic Method: Reflecting on How You Learn
- Collaborative Learning in Mathematics
- Electronic Team Journals
- Team Member Evaluations: Diving into Engineering Teams
- Reflecting on Teamwork After a First-Year Service-Learning Project
- Teaming in Differential Equations
- Open-Ended Design Problems

Thanks to Frank Lee of Bellevue College for these reflection activity categories

PERSONAL DEVELOPMENT & DISCOVERY

- Becoming a "World Class" Engineering Student
- Becoming an Engineering Learner
- Quality Engineering Applies to Students' Learning
- Reflecting in Support of Personal Transformation
- The Stanford Resilience Project
- Talk to Me: Secrets to Success
- Self-evaluations in Geology
- Eliciting Critical Incidents in Focus Group to Encourage Student Reflection on Class Experiences
- Privilege Walk
- Financing Life

Thanks to Frank Lee of Bellevue College for these reflection activity categories

PERSONAL INVENTORY

- My Experience with School
- Synthesizing Your College Experience
- Setting the Stage for the Class
- Goals, Core Values, and Behaviors
- Leveraging Strengths for Success in Math
- Reflection on Intellectual Development
- Core Values and a Stanford Bucket List
- Planning the Next Steps
- Advising++
- An Undergraduate Reflection

Thanks to Frank Lee of Bellevue College for these reflection activity categories

Activity 4c: Analyzing activities – Student perspectives

Key question: How might a student experience the activity that you have identified? What might students learn? What knowledge might they gain? How might they react? Will their subsequent behavior be different?

Instructions
- Working with the same group you were in when you created your reflection activity:
  - Discuss your thoughts on the key question above.
  - Consider using the supporting materials as a resource(s) in order to answer the question.
  - Be prepared to share your thoughts with the larger group.

Supporting materials
- Understanding reflection activities broadly: Student knowledge gains (in this workbook)
- How engineering students experience reflection activities: Student reactions (in this workbook)
- A few alternative lenses for viewing student reflection experiences (in this workbook)

Personal reflection

Understanding Reflection Activities Broadly (ASEE 2017)

Jennifer Turns, Kathryn Shroyer, Terri Lovins, Cynthia Atman

Consortium to Promote Reflection in Engineering Education / NSF 1733474 - Reflection in engineering education: Advancing conversations
Center for Engineering Learning and Teaching, Human Centered Design & Engineering, University of Washington
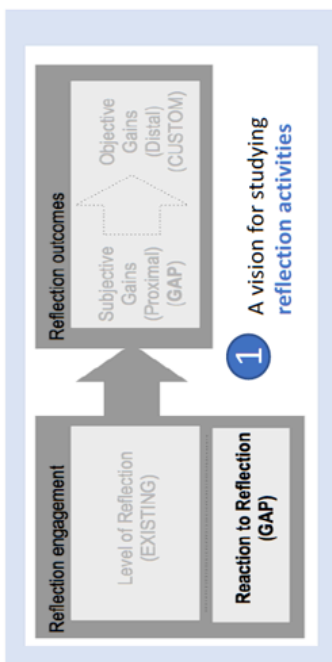
Knowledge gain — The reflection activity helped me to	In-class problem solving with reflection	Friday notecards	study and Preparedness reflection	Motivation / Self-analysis	Racial roles (connecting race/ethnicity to educational experience)
1-Professional					
Learn something but not something related to this [context] or my major.					
Learn something related to the key ideas in this [context].					
Learn something relevant to my major (or planned major).					
2-Personal					
Better understand myself (my strengths, my weaknesses, my preferences, etc.).					
Fit into the campus community.					
See myself as someone who can be successful in my education.					
3-Preparedness					
Prepare me for future employment.					
Prepare me to use reflection as a tool in my future.					
Prepare to do well in my education.					

"It is helpful but having it due a week out might be too long": How engineering students experience reflection activities

Jennifer Turns, Ahmer Arif, Terri Lovins, Bonnie Chinh, Cynthia J. Atman

Consortium to Promote Reflection in Engineering Education (http://cpree.uw.edu)
NSF 1733474: Reflection in engineering education: Advancing conversations
Center for Engineering Learning & Teaching, Human Centered Design & Engineering
University of Washington, Seattle, USA

1 A vision for studying reflection activities

Reflection engagement
- Level of Reflection (EXISTING)

Reflection outcomes
- Subjective Gains (Proximal) (GAP)
- Objective Gains (Distal) (CUSTOM)

Reaction to Reflection (GAP)

2 A conceptual framework for student reactions to reflection activities

Bases	Valence: Resonance	Valence: Resistance
Activity basis		
Cognitive basis		
Self-preservation basis		
Cultural basis		
Epistemological basis		
Mindset basis		
Personal basis		
Instrumental basis		
Situational basis		
Time basis		
Power basis		
Connectedness basis		

Open Questions:
- Are these ideas sufficient for characterizing student reactions?
- How might these ideas manifest in student talk?
- Are some bases more prevalent than others?

3 Illustrating the framework using exploratory analysis of student survey responses on reflection activities…

	Resonance	Resistance
Epistemological basis. Students can have pre-existing assumptions about the nature of knowledge as discussed in theories of epistemology development **WHY: Provocative**	**Metacognition:** "Good for students to observe their mental states and work habits during assigned programs" **Learning about learning:** "The activity was effective and allowed me to better observe the flaws in my study habits" **Self knowledge:** "The activity showed me what are priorities in my life, education and my career", and, "…This activity reminded of why I want to succeed".	**No new skill:** "I DON'T FEEL THAT I ACTUALLY LEARNED SOME SPECIFIC SKILLS". **"No new knowledge:"** "Why do we do these, nobody learns anything from them and they are simply taken for busy work and are often incredibly confusing and vague in directions."
Situational basis. Maslow's hierarchy of needs suggests that some people might have unmet needs that are antecedent to reflection. Others might have needs that can be met through reflection **WHY: Practical**	**Timing:** "It could not have been better timed, I had just finished all of my tests so it was a great time to reflect on all of my midterms" "The reflection activity was well timed. After a quarter of college, it can be easy for a student to regress to high school habits and lose their motivation to succeed. This activity reminded of why I want to succeed." **Alignment with existing situation.** "I do a small amount of reflection after each problem already this activity just made me quantify it."	**Timing:** "The weekend this assignment was assigned was already a busy one and having an assigned, but ungraded assignment, felt like unnecessary added work" **Timing/Alignment:** "I wish we had done it earlier in the quarter, like maybe after one of the exams".
Connectedness basis. Put a short sentence here.. **WHY: Discovered!**	**Connection to educator:** "It was cool. My professors have asked sometimes about how we feel in our own progress, but usually toward the end of quarter. It was nice to have a full term of activity to keep up, and also have so much open communication with the professor." **Connections to students:** "I liked how activities like this involved most people in the classroom" and "It went smoothly and was nice listening to the reports from other students going through the same problems!"	**Missed connections:** "It was pretty quiet, I thought we'd talk more with others."; "I wish that we would have discussed the reflection briefly after turning it in."

Methodological Notes: (1) Data were taken from student responses to a survey about recent experiences with reflection activities. Our analysis focused on student responses to the open ended question: Please use this space to add any other observations, questions, or comments about this reflection activity. (2) Data analysis was deductive (which bases?) followed by inductive (variation within bases?).

Turns, J., Arif, A., Lovins, T., and Chinh, B. (2017). "It is helpful but having it due a week out might be too long": How engineering students experience reflection activities, Proceedings of the Research in Engineering Education Symposium, Bogota, Colombia, July 2017.

A Few Alternative Lenses
For Viewing Student Reflection Experiences

Broccoli or Ice Cream

Consider the Following

- *Ice Cream: Students may like an activity but not feel it was worth their time. Lets call this ice cream. We love it, but its nutritional value is questionable.*

- *Broccoli: Students may feel an activity is worth their time, but not like it. Lets call this broccoli. It's not always our favorite, but we know its good for us.*

Is the reflection activity worthwhile and/or enjoyable?

- Are their activities that are both enjoyable and worthwhile?
- What kind of characteristics might make an RA enjoyable or worthwhile?

Where do our activities live in the space of broccoli and ice cream? Where might your activities live?

Median Response for 98 Activites
"This reflection activity was worth my time."
: "I enjoyed this reflection activity."

Sticky or Slippery

Median Response for 98 Activites
How much of this reflection activity do you remember?

Consider the Following Student Responses

- *I learned that I don't remember if I've done the reflection activity or not*
- *I don't recall the experience...*
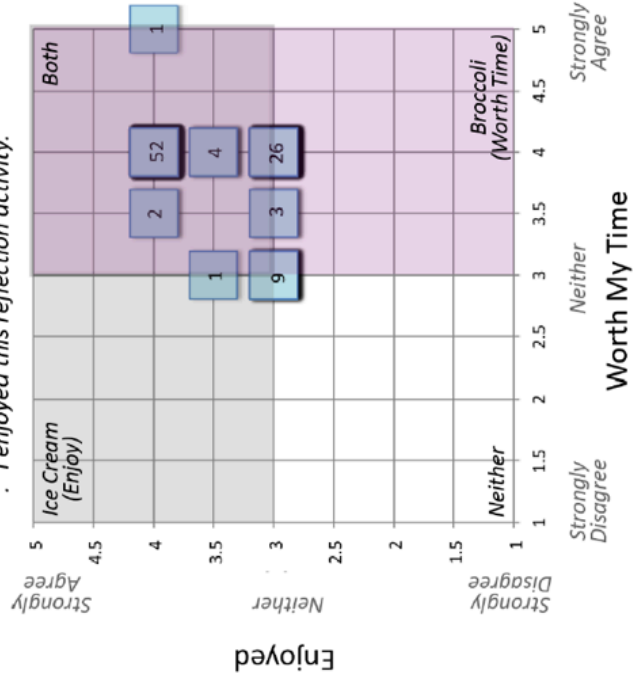- *I hardly remember doing the exercise*
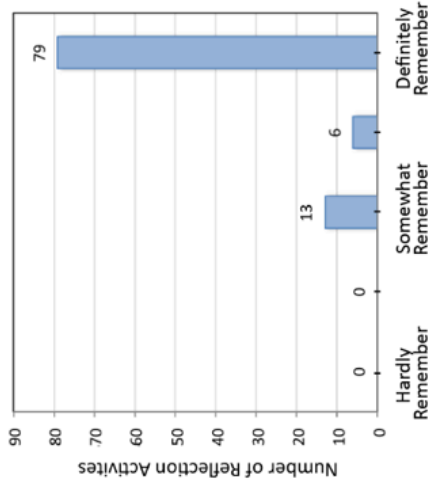
Is the reflection activity memorable?

- *Does a reflection activity have to be memorable to be meaningful for a student?*
- *What makes a reflection activity memorable? Is it the activity itself, the structure of the class, the name, the amount of time, etc.?*
- *Are activities equality memorable to all students?*

One or Many?

Consider the Number of Reflection Activities?

- How many RAs might a student be engaging in at a time?
- Are they in different classes?
- On class?
- Different activities?
- How might this effect their experience?
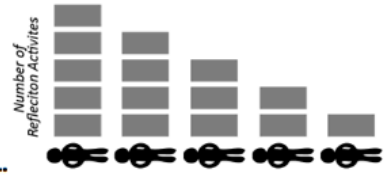
For Me or For You?

Consider the Following Student Responses

- I think that it helped me sit down and actually think about what was working *for me* in the course, in terms of studying, problem solving, and critical thinking.

- I had little take-away from muddiest points. I figured they were for the benefit of *the structure of the course and the professor*

Who is reflection for?

- Do students think the reflection activities are for them or someone else (the professor, other students, the structure of the course)?

- *Are some activities more likely to feel like they are for the student?*

Internal work created by Kathryn Shroyer 2017

Activity 4d: Analyzing activities – Educator perspectives

Key question: What might it be like for the following kinds of educators to do your reflection activity with students: (a) educators new to using reflection activities in their teaching and (b) educators who have experience with using reflection activities in their teaching? How might the experience change for educators over time?

Instructions

- Working with the same group you were in when you created your reflection activity:
  - o Discuss your thoughts on the key question above.
  - o Consider using the supporting materials as a resource(s) in order to answer the question.
  - o Be prepared to share your thoughts with the larger group.

Supporting materials

- Educator perspectives: Professional (in this workbook)
- Educator perspectives: Personal (in this workbook)
- Educator perspectives: Practical (in this workbook)

Personal reflection

Educator Perspectives: Professional

Potential benefits for educators in their professional roles

Reflection activities will benefit my students.

" Surprisingly, some students just can't recognize the actual issue, but when I look at the exam, I can see a pattern repeated over and over again. When you see the trends and students don't recognize it, take the time to point it out. It helps them with their learning and knowing how to improve.

Reflection activities provide useful, timely feedback.

" There was something that I thought was very clear to the students and should not have been an issue, but in the reflections, it kept coming up. That was an example of how we were really able to see, 'Oh, we have been thinking that this is pretty easy and the students know what to do here,' but they don't.

Reflection activities are flexible teaching tools that are easy to use and get quick results.

" I think it is feasible because there are a lot of activities where you don't have to shift everything and trample on its head. You can just add something pretty simple. … I have been doing it kind of piece-wise where I am just adding small little things that aren't disruptive at all. I takes hardly any time, and what I love about it is the students find it rewarding.

Conversations about using reflection activities can build communities of practice.

" We have had a couple of training sessions where we have gotten together as faculty. There is a lot of empowerment in that because I didn't realize how interested other faculty are in the same thing! I have some good new ideas and it is a nice chance to co-mentor each other.

Reflection activities have broad appeal for educators, which can stimulate interaction across departments and disciplines.

" The most valuable thing [about CPREE] was how we have caused a lot of different people across campus to collaborate and share their activities and improve on them.

Educator Perspectives: Personal

A sampling of educator reactions…

"I can't actually change the system, but I can open up this little hour a week that is nurturing and caring and open."

"College education is a way to be an outstanding citizen who is responsible and understands the world around them, and to do that, you need to be getting into the habit of being reflective."

"Am I asking my students to do therapy with me, or am I asking them to be metacognitively aware?"

"I think that my courses are much stronger when I encourage my students to be reflective, and a focus on reflection encourages instructors to be reflective as well."

"They [junior colleagues just out of graduate school] really only know what they have experienced, and so here is an opportunity... to expand on what they know as to what happens in a classroom."

"We don't see this as time-saving for the instructor, we just think that it allows the instructor to devote time to other things that are more beneficial, leveraging the instructor's time. Now I can spend my time in class helping students understand what they did wrong, I can spend my time answering students' questions, and if a lot of them got the same thing wrong and had the same confusion, I can spend my time going over that, rather than just grading."

"They [junior colleagues just out of graduate school] really only know what they have experienced, and so here is an opportunity...to expand on what they know as to what happens in a classroom."

"Some of us have been teaching for years, and some for a couple of decades, and we just are at a stage in our lives where we are ready to expand what it is that we are actually doing in our classrooms."

"[Reflection] is not just an activity that you ask students to do, but it is actually a mental state that you can occupy, and it is a cornerstone to bringing about transformative change in the lives of ourselves and our students."

A sampling of educator concerns...

- Will it take too much time to prepare?
- Will it take too much time out of my class?
- Will my students hate it?
- Will my students benefit from it?
- Can I do it well?
- Is it worth it?

Educator Perspectives: Practical

....

"Tips & Tricks for Successful Implementation of Reflection Activities in Engineering Education"

From the abstract of the paper. "As part of the CPREE project, we documented over 100 reflection activities facilitated by engineering educators from diverse types of institutions and shared those activities for public use in the form of a field guide. The field guide includes an overview of each activity, steps to recreate the activity and tips and inspiration as shared by each educator who offered their specific activity for the field guide. In Thomas, Shroyer, & Atman (2016), the authors present themes that were derived from over 300 individual tips in the field guides for reflection in engineering education. These activities come from many different contexts, have varying depth, time allocations, and other features that make the activities unique, yet the tips yielded similar themes for success. The authors completed a qualitative analysis to identify themes across all of the tips. The themes were organized into three categories: (1) considerations for the reflection activity itself, (2) considerations for students' connection to reflection, and (3) consideration for the educator's connection to reflection (see Table 1)."

Table 1 from the paper

Category	Themes
1. Considering the activity itself	a. Consider whether to grade or not b. Address time and timing
2. Considering students' connection to reflection	a. Help students see the value of reflection b. Address students' possibly limited experience with reflection c. Address engineering students' hesitation about writing d. Acknowledge students' varying preparation for reflection
3. Considering the educator's connection to reflection	a. Be aware of your influence on the students b. Consider learning more about and practicing reflection c. Create an environment that respects the personalness of reflection d. Be prepared to react to what emerges e. Be prepared for the addition of reflection experiences to be an iterative process

Thomas, L.D., Shroyer, K.E., & Atman, C.J. (2016). Tips & tricks for successful implementation of reflection activities in engineering education. In *Proceedings of the American Society for Engineering Education Annual Conference & Exposition*, June 2016, New Orleans, LA.

Part 5
Reflecting

Activity 5a: Synthesis

Key question: What insights have we gained concerning the type of knowledge that is useful to support work related to reflection in engineering education?

Instructions
- Consider the following mad lib:

    To fully appreciate reflection in engineering education, it is helpful to understand ___(a)___ in order to help ___(b)___ to do ___(c)___.

- Working alone, generate ideas for (a) and record them on yellow post-it notes.
- Working alone, generate ideas for (b) and record them on green post-it notes.
- Working alone, generate ideas for (c) and record them on pink post-it notes.
- Consider using the supporting materials as a resource(s) in order to answer the question.
- Be prepared to contribute your ideas to those generated by the entire group.

Supporting materials
- Your prior reflection notes (in this workbook)
- Materials posted around the room

Personal reflection

Activity 5b: Letter to self

Key question: What would you like to remember a couple of months from now?

Instructions
- Get a sheet of paper and an envelope.
- Address the envelope to yourself.
- On the sheet of paper, write yourself a note that contains thoughts you might want to read in 1-2 months.
- Consider using the supporting materials as a resource(s) in order to answer the question.
- Put your note in the envelope and give to one of the workshop organizers.

Supporting materials
- Your prior reflection notes (in this workbook)
- Envelopes - please self address! (in table envelope)
- Materials posted around the room

Personal reflection

Activity 5c: Final thoughts

Personal reflection

Reflection Workshop
Additional Materials

Reflection Workshop Attendees

Robin Adams
Purdue University

Cheryl Allendoerfer
University of Washington

Ahmer Arif
University of Washington

Janet Ash
Green River College

Cindy Atman
University of Washington

Nancy Barr
Michigan Technological
University

Kristen Bergsman
University of Washington

Jim Borgford-Parnell
University of Washington

Janet Brelin-Fornari
Kettering University

Ryan Campbell
Texas Tech University

Adam Carberry
Arizona State University

Monica Cardella
Purdue University

Helen Chen
Stanford University

Youngjun Choe
University of Washington

Scott Clary
University of Washington

Carlos Coimbra Cardoso
Industrial Design
Engineering

Kristy Csavina
Colorado School of
Mines

Patrick Cunningham
Rose-Hulman Institute of
Technology

Stephanie Cutler
Penn State University

Claire Dancz
Clemson University

Dianne DeTurris
California Polytechnic
State University

Doug Faust
Seattle University

Janna Ferguson
Northeastern University

Michael Flynn
Stanford University

Trevor Harding
California Polytechnic
State University

Jen Helms
Inverness Research

Karen High
Clemson University

Brent Jesiek
Purdue University

Cathryne Jordan
University of Washington

Suzanne Keilson
Loyola University

Micah Lande
Arizona State University

Gary Lichtenstein
Quality Evaluation
Designs

Terri Lovins
University of Washington

Ana Luz
Industrial Design
Engineering

Susan Mahoney
University of Cincinnati

Kaitlin Mallouk
Rowan University

Michelle Marincel Payne
Rose-Hulman Institute of
Technology

Reflection Workshop Attendees (continued)

Seda McKilligan
Industrial Design
Engineering

Ann McMahon
University of Washington

Muhsin Menekse
Purdue University

John Moosbrugger
Clarkson University

Indira Nair
Carnegie Mellon
University

Michelle Phillips
Inverness Research

Wendy Roldan
University of Washington

Shima Salehi
Stanford University

Brook Sattler
Expedia

Giovanna Scalone
University of Washington

Kathryn Shroyer
University of Washington

Elizabeth Strehl
Purdue University

Lauren Thomas
Amazon

Julia Thompson
San Jose State
University

Natascha Trellinger
Purdue University

Jennifer Turns
University of Washington

Derrick Van Kirk
University of Washington

Natalie Van Tyne
Virginia Tech

Chris Venters
East Carolina University

Ken Yasuhara
University of Washington

Sarah Zappe
Penn State University

Yevgeniya Zastavker
Northeastern University

CPREE Cumulative Bibliography
September 2017

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Consortium to Promote Reflection in Engineering Education

Co-Directors: Cynthia J. Atman, PhD. & Jennifer Turns, PhD.; Human Centered Design & Engineering
Center for Engineering Learning & Teaching, College of Engineering, University of Washington

Identify and map practices that support reflective thinking

Practices, rationale for use, how students respond, keys to effectiveness, faculty-peer reactions

Produce field guides to support awareness and understanding of reflective practices

Campus-specific and national field guides with a wide variety of practices and how they fit into local institutional contexts

Promote local use, development, and sharing of reflective practices

Activities to develop, refine, and evaluate reflective practices at different scales

Mapping practices

Producing field guides: campus-specific & national

Promoting use & development of practices

Start-up (2014)	Academic Year 1 (2014-2015)	Academic Year 2 (2015-2016)	Wrap-up (2016-17)
Initializing	**On each campus**	**On each campus**	**Conclusion**
Building the consortium of 12 campuses	Mapping reflective activities	Conducting reflective activities with students	Evaluation
	Creating local field guides	Evaluating student and educator activities	Reporting
	Planning Year 2 reflection activities	Staging local CPREE events	**On-going**
	Planning evaluation activities		Dissemination
	Staging local CPREE events		

Across the 12 Partners of the Consortium

Consortium-wide online meetings (2 per month)

Consortium-wide meeting in Seattle (annual)

Evaluation activities

Reports to funding agency

Dissemination including national field guide of reflective activities

Reflection

Reflection can support student excellence and retention by helping students...

- Gain new perspectives on their knowledge and skills, and how to expand them
- Prepare for, seek out, and engage in new learning experiences
- Make informed commitments to studying and practicing engineering

Impact

18,000 student experiences across 12 campuses (1 student experience is an individual student engaging in a reflective activity)

240 educator experiences across 12 campuses (1 educator experience is an individual educator supporting a reflective activity)

Guiding principles

- Promote educator-driven change
- Identify practices that meet local needs and contexts
- Enhance the value and multiply the impact of existing and new educational practices
- Promote the idea of students making informed choices about majors, courses, and careers in engineering

CELT
CENTER FOR ENGINEERING LEARNING & TEACHING

Co-Directors: Cynthia J. Atman, Ph.D. & Jennifer Turns, Ph.D.
Center for Engineering Learning & Teaching, Human Centered Design & Engineering, University of Washington

Reflection can support student excellence and retention by helping students...

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Guiding Principles

- Promote educator-driven change
- Identify practices that meet local needs and contexts
- Enhance the value and multiply the impact of existing and new educational practices
- Promote the idea of students making informed choices about majors, courses, and careers in engineering

Impact

- Over 81,000 student reflection experiences were provided through over 1,100 reflection activities across 12 campuses.
- Over 380 educators administered the 1,100+ reflection activities across 12 campuses.

Updated May 2017

12 campuses

81,000+ student reflection experiences

1,100+ reflection activities administered

380+ educators & administrators

90+ departments represented

25+ consortium meetings

Start-up 2014	**Academic Year 1** 2014–2015	**Academic Year 2** 2015–2016	**Wrap-up** 2016–2017
Building the consortium of 12 campuses	On each campus... • Mapping reflective activities • Creating local field guides • Planning Year 2 reflection activities • Planning evaluation activities • Staging local CPREE events	On each campus... • Conducting reflective activities with students • Evaluating student and educator activities • Staging local CPREE events	Concluding evaluation and reporting Ongoing dissemination
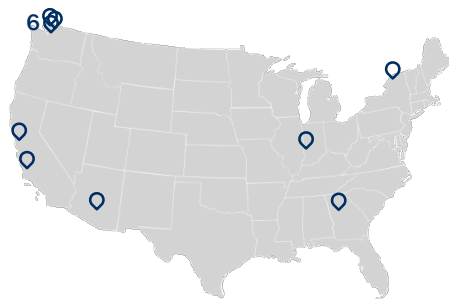
Partner Campuses

- Arizona State University, Polytechnic campus
- Bellevue College
- Cal Poly San Luis Obispo
- Clarkson University
- Georgia Tech
- Green River College
- Highline College
- Rose-Hulman Institute of Technology
- Seattle Central College
- Seattle University
- Stanford University
- University of Washington

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20170522

From our field guides on reflection...

http://**cpree**.uw.edu

Selected Reflection Activities

Exam Wrappers: Reflecting on Study Skills

Campus: Georgia Tech
Educator: Carrie Shepler, Director of Freshman Chemistry
Context: out of class; Introduction to Chemistry series
Keywords: exam, study skills, exam-taking skills, first-year students, metacognition
Student Activity Time: 10 minutes, outside of class

After an exam, students reflected on their exam preparation, their performance on the exam, and their preparation for future exams.

Understanding Environmental Problems through Chemistry

Campus: Bellevue College
Educator: Sonya Doucette, Faculty, Chemistry & Environmental Science
Context: in-class; General Chemistry 163
Keywords: POGIL, sustainability, flipped classroom
Student Activity Time: 50-minute class period

Students used equilibrium chemistry to uncover the concept of chemical buffers in relation to environmental problems.

The Stanford Resilience Project

Campus: Stanford University
Educator: Adina Glickman, Stanford Resilience Project, Founding Director
Context: out of class
Keywords: failure, success, learning, setbacks
Student Activity Time: varied

Students reflect on their failures in service of learning and growing from them to develop their resilience.

See our web site for more activities like these, including Neon Notecards, Mock Interviews, Reading Reflections in Physics, Pain Polls, Interactive Grading, Metals 1.0: Art & Engineering, and White Papers in Math.

Selected Tips from Featured Educators

"Be prepared for students to take the reflection activity seriously."

"Explain the purpose of reflection... Emphasize the practice of looking forward in order to alter future behavior."

"Make sure that students know that their responses are being read."

"Close the loop... Show them that you are reflecting on the feedback they are giving you."

"Balance being specific and open in prompts."

"Be comfortable with pauses. Some students will not automatically step forward to express their experiences."