

Types of Adaptive Learning

Types of Self-led e-Learning, Micro-Adaptive Systems
and Algorithm-Based Systems

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Types of Adaptive Learning

Introduction

We all have experienced the difference between working with a great personal tutor and sitting through a mass lecture. Adaptive technologies personalize learning, so that on-line learning is more like working with that personal tutor and less like sitting through the mass lecture.

The aim of this White Paper is to provide the novice with a simple introduction to the range of adaptive technologies in use. It is not intended as a technical review of the field.

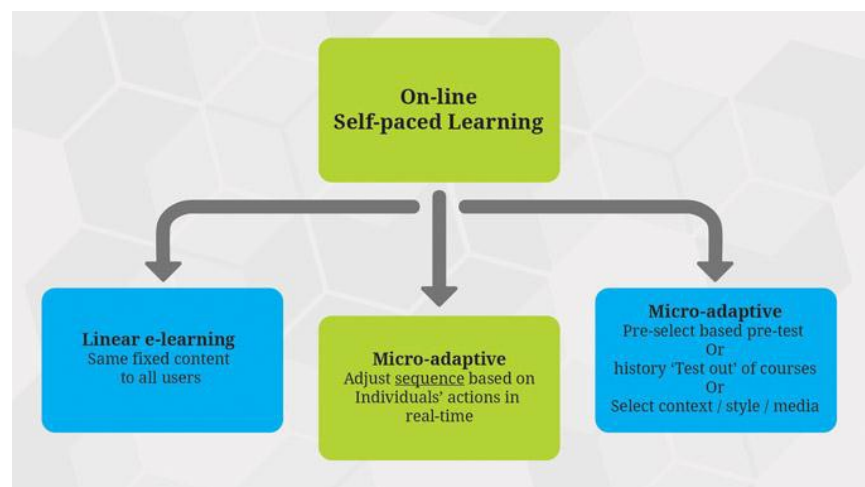
The term “adaptive” is applied to a wide range of approaches – from basic pre-test systems that allow users to “test out” of elements of a course, all the way to sophisticated algorithm-based learning engines. This White Paper sets out some of the different forms of adaptive technology, their applications and their benefits and drawbacks.

Much of the current excitement around adaptive learning is focused on systems that apply modern research in learning. They offer the opportunity to bring sustained improvements to on-line learning by applying a more scientific approach to learning delivery.

Types of Self-led e-learning: Linear e-learning, Macro-Adaptive and Micro-Adaptive

We all have experienced the difference between working with a great personal tutor and sitting through a mass lecture. Adaptive technologies personalize learning, so that on-line learning is more like working with a personal tutor and less like sitting through a mass lecture.

At the highest level, self-paced e-learning delivery systems can be divided into linear, macro-adaptive and micro-adaptive.



Linear systems refer to the traditional, fixed-sequence e-learning that we all are familiar with. They deliver the same content in the same predetermined sequence to each learner.

Drawbacks:

- If the student already knows part of a course, they still have to work through every step – wasting time and decreasing engagement.
- If the student has problems at any point, there is no immediate help available.

Applications: Short learning experiences (< ~ 20 minutes) that are self-contained and will not be built-on or repeated in the future.

Macro-adaptive systems tailor learning to an audience, usually based on a prior profile of the learner's or group's needs. Macro-adaptive systems typically evaluate the user or audience before they take a course and then select in advance how the course is delivered to the individual or group. They split into two main types:

The first type uses information on the learner’s personal preferences to tailor the media, context or style of learning activity delivered.

Drawbacks:

- There is little research evidence to support these approaches.
- They require additional content development without clear benefits.

The second type uses a profile of the learner’s existing capabilities or knowledge to allow them to “test-out” of elements of a course. These pre-test systems can save learning time by using a snapshot of the learner’s knowledge.

Drawbacks:

- The snapshots are quickly out dated as the learner works through the course.
- Too much reliance on point-in-time testing.

Applications: Macro-adaptive systems are typically pre-test systems that allow students to test out of linear e-learning courses. This type of “testing out” can have practical uses, but delivers limited learning benefits.

Micro-adaptive systems offer the most effective form of personalization and are most aligned with the underlying research on personalization. In contrast to macro-adaptive systems, micro-adaptive systems continuously tailor learning delivery, based on the student’s ongoing actions at every step.

Benefits:

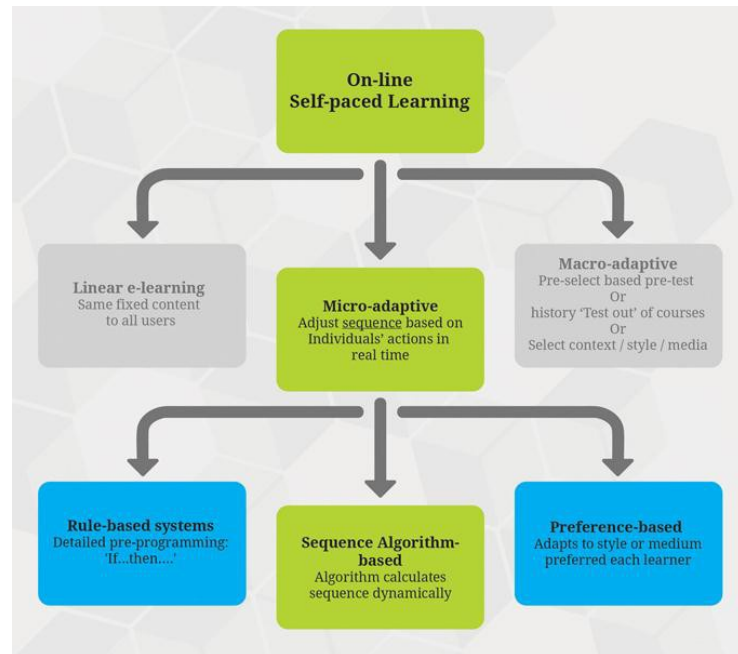
- Dynamically adjust to the student, based on their most recent actions.
- Allow the learner to skip unnecessary activities.
- Provide automated, personalized support for a learner.

Drawbacks:

- No significant educational drawbacks.

Types of Micro-Adaptive System: Rule-based, Preference-based, and Algorithm-based

Micro-adaptive systems can be divided into three further categories of preference-based, rule-based, and algorithm-based.



Preference-based micro-adaptive systems are similar to preference-based macro-adaptive systems, but learn the specific user's preferences as the user progresses and then deliver content accordingly.

Drawbacks:

- There is little research to support this approach.
- They require additional content development without clear benefits.

Rule-based systems rely on pre-programming of how the system responds to the user's actions – e.g. “if the user selects answer b), go to the next item on the list OR if the user selects item a), go to a further test” etc.

Benefit:

- High level of control by the author.

Drawbacks:

- Require time-consuming programming
- The “hard-wired” nature of these courses limits extendibility and re-use of adaptive routines.

Applications: Rule-based systems are most applicable to subjects such as basic math and basic science.

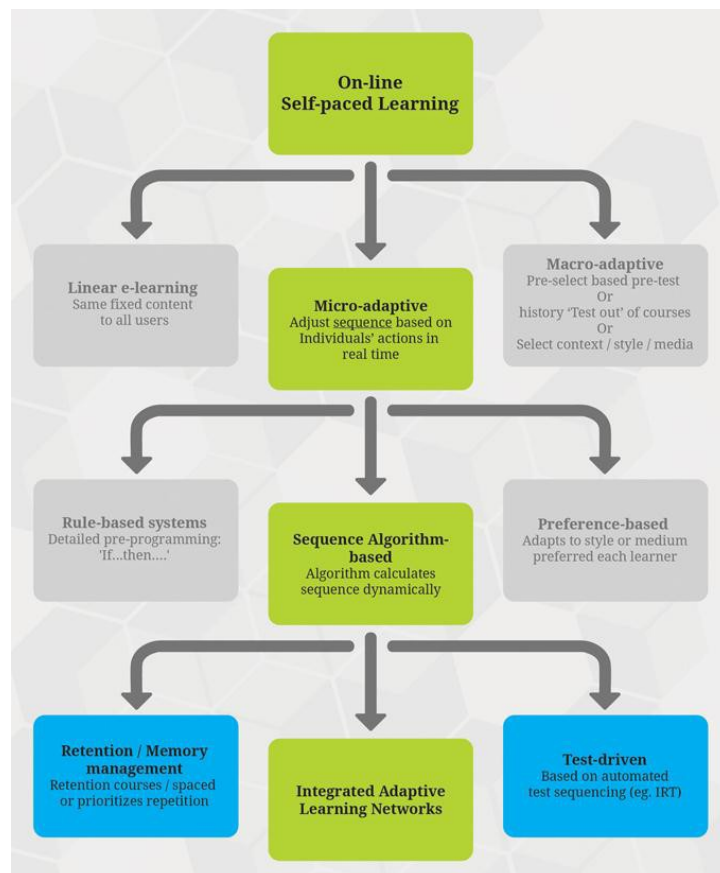
Algorithm-based sequence systems use data-driven algorithms to determine the most appropriate learning sequence for each individual, as they progress. This type of system uses current data to assess what the learner needs at any given point.

Benefits:

- Require less time to develop.
- Dynamic data-driven approach
- Amenable to self-improvement and data analysis

Types of Algorithm-based Adaptive Sequence Systems: Repetition, Adaptive Assessment, and Integrated Learning Networks

Algorithm-based adaptive sequence systems offer the opportunity for highly scalable improvements in on-line learning. Again, they can be divided into three major categories: Memory retention systems, adaptive assessment-driven systems and integrated learning and assessment networks.



Memory retention systems have their roots in Ebbinghaus' experiments on memory and forgetting. The dramatic loss of memory in a short period of time can be addressed through certain forms of repetition. The latest research offers a sophisticated analysis for prioritizing repetition events, based on data about the individual, the learning activity and the interaction between the two.

Benefits:

- Based on sound learning research.

Drawbacks:

- More narrow areas of application.

Memory retention systems are most applicable to memory intensive learning activities such as learning language vocabulary or medical exam study.

Adaptive assessment-driven systems have their origins in adaptive assessment itself. Typically, in adaptive assessment, a set of assessments is presented to a population of users and the results are statistically analyzed (frequently using a method called Item Response Theory). Based on the analysis, the assessments are ranked in terms of differentiation (how well they assess what the learner knows) and difficulty (the relative likelihood that a member of the population will get the assessment correct). This data can be used to optimize individual assessments and dynamically adapt the sequence of assessments.

Adaptive assessment efficiently identifies a learner's level of knowledge with respect to the population of other learners, within a specific bank of questions. Some learning systems use IRT-based adaptive assessment to direct the learning activities delivered to users.

Advantages:

- High quality open source IRT analysis tools are available to enable analysis of tests and assessments.

Drawbacks:

- With the possible exception of exercise drills and test preparation, it is uncertain that the methods used for adaptive assessment transfer to learning delivery.
- A heavy focus on testing detracts from learning effectiveness.

Applications: These types of systems are often applied to test preparation (e.g. SATs), exercise drills or teach-to-test situations.

Integrated adaptive learning networks combine elements of adaptive assessment and retention theory with other learning theories and recommendation engine methods. This is one of the most advanced forms of adaptive technology.

Learning activities (assessments, content, and other activities) are stored in a network, with learning relationships defined between them. As the student works through a topic, an algorithm is used to identify the next most appropriate item in the network for the student.

Inputs can include the learner's knowledge profile, elements of the learner's behavior, retention, recommendation, and profile data. These inputs are used to provide a recommended sequence to the learner. At each new step, the sequence is recalculated based on the latest information about the learner.

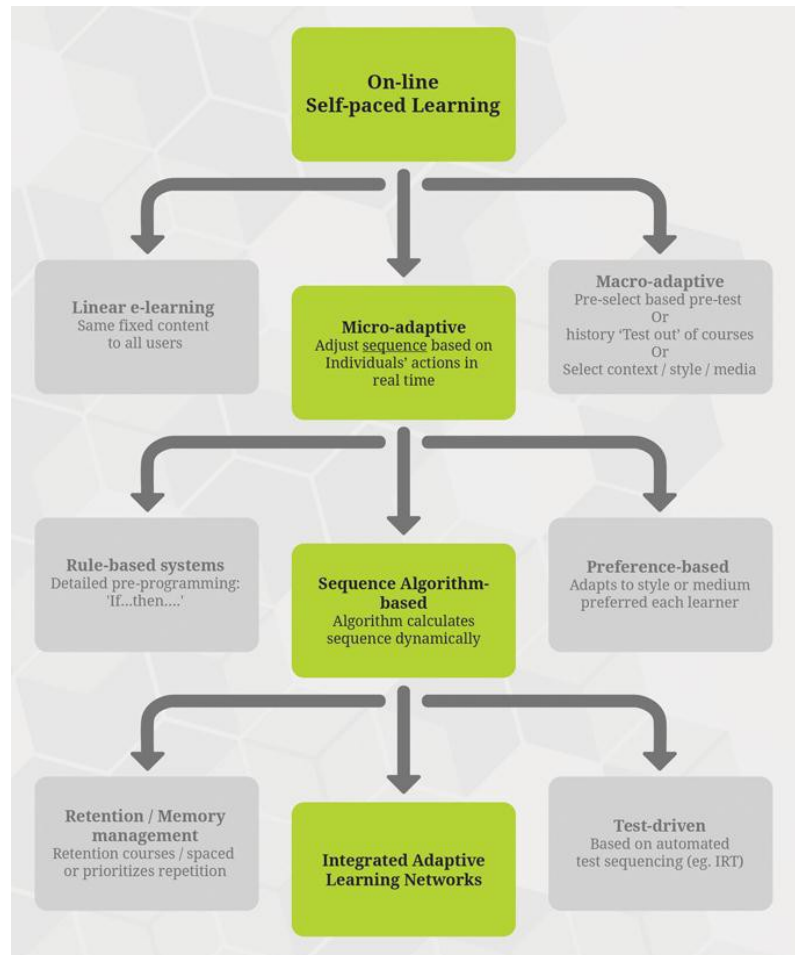
In this way, the learner receives highly personalized support at each step, tailored to their learning needs at that point.

This type of system offers more flexibility and scalability than other systems and offers other major potential benefits

The CogBooks Adaptive Learning Network

CogBooks is an adaptive learning network system.

The unique architecture and adaptive engine of CogBooks combine to deliver a sophisticated and powerful learning system.



Benefits of the CogBooks integrated adaptive learning network

For Institutions

- Content agnostic: supports any topic or subject
- Supports large-scale adaptive curriculum development
- Enables massive-scale delivery of personalized learning

For Authors

- Easy to use authoring and easy management of large learning networks and curricula

- Enables re-use and integration across topics
- Provides data for analysis and course improvement

For Instructors

- More granular data for instructors to direct student support
- Flexible modes to support various instructional uses
- Easily customizable to each class or cohort

For Learners

- Based on modern research-led learning theory
- Learn more quickly
- Receive personalized support when needed

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