

# Adaptive Learning

## Scenario

For years, Dr. Hamilton has taught a course on scientific reasoning that most incoming students are required to take. Because the course is designed to provide students with a common set of skills for science curriculum, including social sciences, it includes some math, a survey of basic science and the scientific method, some logic and critical analysis, and a unit on quantitative reasoning. Each semester the course enrolls more than 150 students, and they arrive with wide differences in skills in these areas.

Over the summer, Hamilton redesigned the course using an adaptive learning system that the college is implementing. She combined her longstanding lessons with some of the content provided by the system and worked to match activities and assessments with discrete learning objectives. She sought help from an instructional designer to set up the sequencing that will accommodate the range of student abilities.

Now, several weeks into the fall semester, she is really starting to see the benefits of adaptive learning (and the rewards for the effort she put into it). Some students have an aptitude for logical thought, even if their basic math skills are weak. Others have a shaky understanding of basic science concepts but are strong in statistics and research. Still others have weaknesses across the board, and a few are strong in all areas. For all of the students, the adaptive learning system provides content and sequencing appropriate for where they are in the curriculum. The general shape of the course is the same for all students, but within that structure, frequent assessments give insight about how students are faring, pointing to optional paths that could help keep them challenged. Depending on their progress, students can see different learning activities, in different media, and in a different order.

Hamilton and her TAs can monitor progress and devote their attention where it will have the most impact—for lagging and high-achieving students, but also for those who are in the middle. She believes that all of the students in the course are receiving a better experience because of the benefits the system provides. And, in subsequent terms, the system should get even better because it will build on the results each semester. Hamilton can also make changes to the content, assessments, and sequencing—either during the term or between terms—to improve it even further.

## 1 What is it?

Adaptive learning is one technique for providing [personalized learning](#), which aims to provide efficient, effective, and customized learning paths to engage each student. **Adaptive learning systems use a data-driven—and, in some cases, nonlinear—approach to instruction and remediation.** They dynamically adjust to student interactions and performance levels, delivering the types of content in an appropriate sequence that individual learners need at specific points in time to make progress. These systems employ algorithms, assessments, student feedback, instructor adjustments/interventions, and various media to deliver new learning material to students who have achieved mastery and remediation to those who have not.

## 2 How does it work?

The systems generally fall into three groups. Closed systems come with existing, off-the-shelf course content to allow for rapid implementation. Open systems allow users to control all of the configuration and content decisions. Hybrid systems allow for limited configuration, such as selecting lessons to be included in the course or importing course content. There is a movement toward the hybrid model because it balances the time needed to develop an adaptive learning course with the flexibility for faculty to control content and assessments. For modules within the adaptive learning system, the learning content, the concept sequencing, and the assessments are set up to reflect the learning objectives for the course. Systems display content based on the performance of students of similar demographics or abilities, or they use predetermined learning paths based on assessment data. As students progress through a lesson, they may see information presented in various ways, tailored to their learning needs. **The systems “learn” from student interactions and then adjust the path and pace of learning.** If the system is open or a hybrid, faculty can adjust algorithms, content, and assessments to the needs of students each semester.

## 3 Who’s doing it?

Various publishers and other content providers—including Cengage, Khan Academy, McGraw-Hill, and Pearson—have developed adaptive learning tools. New vendors such as Acrobatiq, Cerego, CogBooks, Realizeit, and Smart

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Sparrow provide systems that can be customized. **Adoption of these tools varies from individual instructors to institution-wide implementations**, such as Colorado Technical University's intellipath project. Arizona State University is using adaptive learning as part of a high-tech, high-touch strategy, specifically for flipping gen-ed courses and using adaptive systems to support the move from lectures to active learning. At Northern Arizona University, 48% of freshmen are first-generation students, and adaptive learning supports these students through individual pacing and teaching. The University of Central Florida is exploring adaptive learning for individual modules and units, as well as for complete courses in various formats (face-to-face, blended, online). Many of these efforts target high-enrollment gen-ed courses and those with large at-risk populations. The Association of Public and Land-grant Universities (APLU) selected eight universities to receive grants for a three-year project in adaptive learning: Arizona State University, Colorado State University, Georgia State University, Northern Arizona University, Oregon State University, Portland State University, the University of Louisville, and the University of Mississippi.

## 4 Why is it significant?

For students, adaptive learning respects their prior knowledge, responds to their learning needs, and reduces gaps in their understanding. By ensuring that students reach mastery before moving on, adaptive learning avoids "teaching to the middle," which fails to account for advanced students or those who are lagging. Meanwhile, instructors can more easily monitor which students need assistance, measure curriculum performance, and maximize learning outcomes. Instructors can have a better sense of content areas where students are struggling, and system metrics allow intervention before individual students are at risk of withdrawal or failure. In these ways, the role of the instructor changes from content provider to learning facilitator. For the institution, **adaptive learning enables the delivery of personalized learning at scale**, contributing to greater levels of academic success for more students in a cost-efficient manner, while reducing cheating because the content and assessments can vary for each student.

## 5 What are the downsides?

Adaptive learning can be costly and time consuming to implement. **It requires detailed curriculum mapping and content development** that supports learning objectives, and sometimes those objectives require delineation. Content has to be designed at the lesson and objective level, and concept

interconnections must be determined across the course or across connected courses. Some faculty are concerned about the role of adaptive learning systems and how to use them effectively. The algorithms used in adaptive applications vary widely, and vendor reluctance to share the details of their products raises questions about how adaptive the systems really are and, as a result, whether they are worth the money and effort. Also, because the model tends to work better with factual and procedural knowledge, adaptive learning is typically more applicable to entry-level courses in certain fields; when the material demands higher-order thinking, these systems might be less effective. In another example, adaptive learning might work better in self-paced or competency-based programs, but many academic models still rely on fixed-term calendars of semesters or quarters. More research is needed to address these questions.

## 6 Where is it going?

As with other tools based on analytics, **adaptive learning systems will improve as data are collected on more students over time**. Vendor offerings and libraries of course materials are growing, making it easier for faculty to obtain off-the-shelf course content for adaptive learning applications. Institutions are experimenting with stretching the boundaries of academic terms to allow for variable time to achieve learning mastery by students of varying skill levels. The role of faculty may evolve, with instructors developing more flipped and project-based courses that focus on critical thinking and problem solving. Meanwhile, emerging standards from groups such as IMS Global are being developed to promote interoperability and the exchange of data across platforms and tools.

## 7 What are the implications for teaching and learning?

Adaptive learning can be an effective way to bring individualized learning to large numbers of students for courses that lend themselves to the assessments, learning goals, and concept sequencing that adaptive learning requires. Particularly in high-enrollment classes, **adaptive learning can provide tailored support and guidance to all students**. Within the context of the overall learning process, adaptive systems can support changes in the role of faculty, enable innovative teaching practices, and incorporate a variety of content formats (text, graphics, video) to support students according to their learning needs. At the same time, these tools can furnish new evidence about the relative effectiveness of varying sequences and approaches to learning.