Designing Personalized Adaptive Learning Courses at the University of Central Florida

ELI BRIEF

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Adaptive learning technologies are emerging as an effective way to promote access and quality at a large scale in education. Enabled by machine learning, these technologies can provide each student with a personalized learning experience that helps accelerate a learner’s performance while adapting to his or her needs and skill sets in real time. From a pilot program, the University of Central Florida (UCF) has learned important lessons about how courses, faculty, and students change with adaptive learning.

Introduction

In spring 2014, UCF started to investigate adaptive learning products to improve student learning success. We reviewed many available products, and faculty chose Realizeit because the platform is content agnostic, meaning that the product supplies the adaptive software infrastructure but not any content. This gives instructors the freedom to create and edit their own content, including text, videos, graphics, etc. The second reason Realizeit was chosen was because both the content and the assessments are adaptive. In this type of system, content is presented to the student in small chunks and is followed by several assessment questions. If students excel in a particular content area, the system will move them toward advanced content and questions. If students are not doing well in a particular area, the system will recommend that they review content areas where their knowledge is weaker and will decrease the difficulty of the questions. The amount of content and the types of assessment questions depend on how much information and how many questions are created and entered into the system by the instructor or course builder.

The Center for Distributed Learning (CDL) led two pilot adaptive courses, Pathophysiology for Nursing Practice and General Psychology, in the Fall 2014 using Realizeit. With the assistance of Realizeit course builders, the nursing instructor created three case studies for the undergraduate course. She has since extended the use of Realizeit into her graduate pathophysiology course. The psychology professor delivered his entire course in Realizeit, with supplemental readings required in the textbook. Since the pilot study, Realizeit has been applied to many more courses, such as College Algebra, Intermediate Algebra, Statistics for Educational Data, Professional Administrative Writing in the Public Sector, and a variety of software development and IT courses from the bachelor of
applied sciences degree. Currently at UCF, adaptive learning can be integrated in all course modalities, including face-to-face, mixed-method, and fully online.

Course Changes

Adaptive learning courses are different from traditional courses in both content and assessment.

Content

Good content is important in any course, adaptive or otherwise. The granularization of the content, the overall organization, and the amount of content are key elements to consider for designing adaptive learning courses. In adaptive courses, designers break content into small sections or “chunks” and decide where one topic (or subtopic) ends and another begins. These chunks of content and formative assessment are organized into learning paths based on a prerequisite structure. For example, students move from left to right across the learning map, completing the necessary prerequisites before moving on to the post-requisites (refer to figure 1). This breakdown and organization are important because a student who may be struggling with a post-requisite may have to revisit the associated prerequisite(s) to improve and achieve mastery. It allows students to see which concepts are connected and to pinpoint where knowledge gaps may exist.

![Figure 1. Pathophysiology learning map for hematology module. Each node contains both content and assessment.](image-url)

The nonlinear nature of most adaptive content is another change related to organization. In traditional, nonadaptive courses, content is often linear with little
or no branching of topics or student choice. With adaptive learning maps, students can take personalized paths through the content, visiting areas they want or need to, or as the adaptive system deems necessary. Students can exercise choice by personalizing their path by choosing which content to interact with next.

In the process of organizing content into nodes, we found that, relative to traditional courses, adaptive courses needed additional or alternative content. The content that was used in most courses considered for the pilot originally consisted of PowerPoint slides, PDF documents, and some basic content pages. For the adaptive versions of these courses, we enhanced many of the topics and subtopics in each learning map (or module) with additional text, embedded videos, detailed examples, and other resources. These different types of examples and the various forms of media encompass diverse student learning preferences and incorporate universal design for learning principles. Some of these principles include providing multiple means of representation (e.g., these different forms of media and examples also help provide variation so students who revisit topics do not keep seeing the same static text and examples over and over again); multiple means of engagement (e.g., the Intermediate Algebra course allows students to select an area of study, such as engineering or hospitality, at the beginning of the course and then are subsequently provided with several questions related to that area of study, making these questions personally relevant); and multiple means of action and expression (e.g., the adaptive learning system encourages students to practice areas where they are not as strong; it also provides them with choices related to tasks or content areas they should work on). Content and examples were either created or drawn from open educational resources (OER).

**Assessment**

The other major component of an adaptive course is the assessment piece. Using formative assessment, questions related to each node were linked to the content. Similar to the content, a greater number of assessment items and forms of engagement were needed in our pilot adaptive courses compared to traditional courses. When existing assessment items were spread out across the appropriate topics on a learning map, some topics included too few questions or other types of interactions. Additional questions had to be created (or pulled from OER) for each node to engage students and adequately assess their learning. Realizeit assesses student learning through a variety of metrics, but because much depends on direct engagement with formative assessment, including an adequate number of assessment items is crucial.
Feedback is another necessary component for this type of system. Because adaptive learning uses formative assessments to scaffold student learning, providing immediate and relevant feedback to students is imperative. The feedback provided with each assessment item and throughout high-level examples (e.g., between steps in a case study) was created and entered into the system to help guide the learning process for students. This feedback could include the correct answer, why a particular response is correct (or incorrect), or recommendations of topics for the student to review.

Large question banks are essential in adaptive learning in the event that students revisit topics; these banks also provide options to deliver different questions so that students do not see the same few questions every time. Additionally, Realizeit contains a robust variable system that helps algorithmically clone questions based on the variable and condition definitions. For example, if one mathematical question is created using variables, the system will automatically generate different values for the variables based on the given parameters. This one question could essentially be turned into several because numerous different instances can be algorithmically generated. Every student will receive a question with different variable values on each attempt to solve one particular question problem. Use of variables and conditions in Realizeit can allow for robust adaptive assessments and engagements.

**Faculty Perspectives**

As we explored the new adaptive system, it became clear that faculty would require a new mind-set. We realized that we needed an entirely new approach for the creation of this type of course. We had to consider what faculty would need in this new endeavor and whether any changes were needed for our systematic, sustainable, and scalable approach to designing and delivering adaptive courses.

**Faculty Mind-Set Change and Buy-In**

The advent of adaptive teaching and learning systems required a substantive change for faculty, and we were fortunate to have some remarkable early adopters who were willing to rethink how they teach online and come up with unique strategies for teaching adaptively. Subsequently, when we brought new faculty into the realm of adaptive learning, we emphasized that they would be pioneers in something new and exciting. This enabled them to think outside the box to test
the grounds as the technology evolved. The early adopters have continued to be important supporters of these strategies and were always willing to participate in demonstrations and presentations to highlight the use of adaptive learning for other interested faculty. This is critical for the diffusion of innovation.

Constructing the student experience requires quite a bit more thought as faculty work to granularize and prioritize the course topics or objectives. The design and development of these courses, as mentioned earlier, allow faculty to emphasize traditional online teaching methods and best practices while exploring new avenues of learning science for promoting student success. By building courses that address more of a student’s individual learning needs, faculty are able to focus on student learning gaps in a more expedient way. Some of these building strategies included:

- Using alternative content (e.g., images, video, pencasting), which allows the system to provide more personalized preferences to students
- Adding questions with variables and conditions to provide unique experiences and branching opportunities
- Creating questions at different levels of Bloom’s taxonomy based on a level of difficulty that is easy, medium, or hard
- Applying a mix of adaptive and performance-based assessments (e.g., a combination of an adaptive module and a performance-based project)

Teaching with adaptive learning also changes the role of faculty. Faculty are now asked to consider newer teaching strategies that emphasize facilitation (e.g., no longer being the “sage on the stage,” but now becoming the “guide on the side”). With students following their own personalized paths, the instructor starts to observe them through intricate learning analytics, which suggest to faculty when and where to intervene. They no longer need to wait for a midterm exam to gauge issues in student learning—they can instead detect potential problems early.

Some of the challenges we experienced during this part of the implementation required unique solutions.

- Building an adaptive course proved to be quite time consuming, which was difficult for busy faculty. Although our faculty as a whole preferred the ability to create and modify content as needed, they quickly saw that for the system to work properly it would require much more content than they had available. We assisted them by offering to build the courses with their content or help
them in the use of OER. This eased some of the pain of time consumption for the faculty who were starting from scratch.

- One of the most thought-provoking changes in adaptive learning is moving from strictly summative to formative assessment. This has been a leap for many faculty since summative assessments have been a central part of education for so long. Moving to real-time formative assessments—including interactive content with immediate feedback—can be difficult for faculty members. This is where our initial faculty have proved to be invaluable by sharing their experiences. Once faculty begin teaching adaptively, they are able to see the benefits of this more formative assessment approach.

- A third challenge that revealed itself early on was how to approach the course organization. Most faculty were not ready to relinquish projects and other forms of assessment to have what we called a “true adaptive” course where all modules were fully built in Realizeit. To alleviate these issues, instructors can now integrate adaptive learning components into courses as supplements while still keeping other components as integral parts of the course. Adaptive learning was first employed only in fully online courses, but now it has expanded to mixed-mode and face-to-face classrooms. These options allow faculty to include more performance-based assessments within the course modules. Figure 2 is an example nursing course in which the faculty member taught with adaptive content modules in combination with face-to-face class meetings, proctored exams, and collaborative projects.

![Course organization with adaptive content modules supplemented with classes and exams](image)
Faculty Development and Consultations for Adaptive Learning

As our team began to learn more about Realizeit, we were able to formulate a plan to address faculty development needs. We began with an analysis of our premier faculty development course, IDL6543-Interactive Distributed Learning, and used part of IDL6543 as the basis of our adaptive learning training. We found that we needed to add new elements and create a new workflow process.

Initially, faculty were asked to complete the mixed-mode IDL6543 training with additional requirements. In our 10-week-long training with a special focus on adaptive learning, we increased the number of consultations from four overall to one per week. The additional consultations enabled us to impart all aspects of adaptive teaching and learning to faculty. The consultations were planned based on our traditional instructional design sessions with faculty. Consultations consisted of traditional instructional design components including analysis, design, development, implementation, and evaluation.

After several semesters, the modified version of IDL6543 evolved into a new training program called PAL6000-Personalized Adaptive Learning. Faculty will complete the new online course at their own pace starting in Fall 2017. Delivered within the Realizeit system itself, PAL6000 covers topics such as instructional design techniques, organization, enriching the content, enhancing assessment, grading, and course management. Each topic builds on the previous one to help the faculty complete the “Build Your Course Project” section, which results in one completed adaptive course module. A series of consultations with the assigned instructional designer will be scheduled at the faculty’s request. The final consultation will provide the faculty with all the tools they will need to “go live” for their first implementation of their adaptive learning course. One of these tools is a Course Building Plan that maps out milestones and due dates to keep faculty on track to complete building the whole course. Faculty commented that this sequence provided them with a streamlined approach to an innovative pedagogy.

In the future, instructional designers on the PAL team will continue to work with faculty on reiterations of their courses as they seek to use more aspects of the adaptive systems. Instructional design consultations will be expanded to topics that include assisting faculty with course analysis, organizing content, learning analytics, and making decisions for student success (e.g., grading, types of assessment).
Student Changes

With the changes to content and the faculty role in an adaptive course, the student experience in a traditional online course also changes, so students must learn to adjust how they interact within the adaptive learning course.

Student Experience

When students first access an adaptive learning module, they are prompted to complete a Determine Knowledge activity (see figure 3), which tests a student’s knowledge state (level of mastery) on the module topic. Completion of the Determine Knowledge option is not required but strongly encouraged. If a student chooses to complete this option, the system will deliver questions from the nodes across the learning map. If students perform well on certain topics, they can essentially skip over content they already know and focus on new knowledge areas or areas where their knowledge may be lacking. Whether or not students complete the Determine Knowledge activity, they have the option to select the unlocked nodes on their learning map that they wish to complete. Locked nodes require the associated prerequisite node(s) to be completed before they become unlocked.

![Figure 3. Student dashboard with Determine Knowledge option](image)

Depending on how a course is set up, students have the ability to progress through some or all of the course based on their demonstrated mastery. For example, in Fall 2016 in the Intermediate Algebra course with a student
enrollment of 300, students had the opportunity to move through the entire course. The instructor encouraged this by providing students with the ability to advance at their own pace. Those students who had successfully completed the course within six weeks were able to proceed to the subsequent course, College Algebra, within the same semester. Of the 300 students, 13 completed both courses in the same semester.

In addition to moving through an adaptive learning module, students can go back and revise any node to improve their score. As opposed to a traditional course, which only offers one opportunity to show understanding, adaptive learning courses have the ability to provide as many opportunities as students need to demonstrate mastery.

Student Resources

To assist students in their approach to adaptive learning, we have developed the following resources to help facilitate the personalized student experience:

- **Online tutorial**: Introduces the basic controls and elements that can be expected when using the adaptive learning platform. The online tutorial is currently being updated and will be available in August 2017.

- **Course support information**: Provides necessary information about the adaptive learning modules in the syllabus and throughout the course.

- **Online guides**: Provides students with introductory information and basic technical requirements such as recommended browsers, operating system, and screen size.

- **Webcourses@UCF Support service**: Provides technical support for faculty and students who are enrolled in online courses via telephone, e-mail, and online chat.

Future: A Scalable Plan

Overall, adaptive learning has had successes with the early pilot courses. Our instructional designers have been working closely with faculty and students to help them adapt to the teaching and learning changes. UCF has been implementing adaptive learning to improve student success in courses that have traditionally had unacceptably high levels of D and F grades and course withdrawals (DFW), and in large-enrollment gateway courses into science,
technology, engineering, and math (STEM) or other majors. In addition to Realizeit, instructors in specific disciplines have adopted other adaptive learning systems, such as ALEKS and LearnSmart from McGraw-Hill and MyLab from Pearson. Dedicated instructional designers at CDL are committed to providing pedagogical and technical resources to assist faculty in successfully integrating these adaptive systems that fit best with their teaching needs.

Considering the complexity of adaptive learning and the varying nature of the courses, we are exploring a plan that is adaptable to different platforms to support the various needs of students and instructors at UCF. Adaptive learning courses are expanding to several types of course modalities at UCF. Currently, adaptive courses can be integrated into all of the UCF course modes: fully online, mixed-method or blended, and face-to-face. However, a new course mode, reduced adaptive (RA), will be dedicated to adaptive learning starting in fall 2017. For this new modality, CDL is partnering with instructors to redesign large-enrollment gateway business courses with adaptive learning. Figure 4 illustrates the flipped design of these new RA courses. Each class is divided into six groups that meet in face-to-face classrooms for active learning activities five times each semester. During the rest of the semester, students complete self-paced independent learning in the adaptive learning system we call the “flipped adaptive model.” Different from traditional mixed-method courses, the RA courses have less than 20% face-to-face time dedicated to classroom active learning. This flipped adaptive model will be rolled out into other disciplines such as chemistry and engineering in the near future.

**Figure 4. Flipped adaptive design**

Such a flipped adaptive model incorporates social learning within adaptive courses to promote both learning cognition and engagement. While students
independently follow their personalized learning path, they still have opportunities to collaborate in groups and share resources in face-to-face meetings. Instructors can form in-class small groups based on students’ interests and the progress that is indicated in the adaptive system. However, considering that no current adaptive system has synchronous capabilities, strategies to integrate social interactions remain areas to be explored in the future, especially for fully online adaptive courses where face-to-face meetings are impossible. In the meantime, we will continue to work closely with any faculty who wish to take on the challenge of adapting their courses.

**Notes**


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