White Paper

A Guide to Integrating prepU into Your Course

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What is prepU?

prepU brings together best practices in learning, technology and assessment to provide a unique adaptive quizzing tool for students and instructors.

Why adaptive?

A conventional test is created to serve the needs of an average student. Not all students are average and so in an adaptive test, each of the students is given an individually tailored sequence of items from a pool of items which differ in difficulty. Adaptive learning systems essentially harness the features of an adaptive test but in a learning context. In other words rather than having a test which adapts question by question to a student, a learning system may adapt quiz by quiz, or students may keep working towards one learning goal until they have mastered it—regardless of the time it takes. Adaptive learning is based on the premise that students progress along a learning trajectory at their own pace and this progression is dependent on demonstration of proficiency.

Adaptive Quizzing in prepU

prepU is an adaptive quizzing system designed to provide students with an environment in which they can effectively and efficiently

practice and master course content. The prepU platform is used in numerous course topics across the nursing curriculum, including NCLEX preparation and review courses.

prepU was designed to provide students an environment in which they can practice and learn. And so, when taking adaptive quizzes, we are not necessarily interested in pushing students through the system as quickly as possible. Moreover, we have designed prepU to maximize student learning and provide detailed data on patterns of responses that will help inform both teacher practice and student's knowledge of their own understanding.

Grounded in Research

Not only does prepU harness the power and efficiency of adaptive testing models, it also exemplifies many of the best practices in learning as evidenced by research on retrieval practice. Retrieval practice essentially describes the process of retrieving information from your memory. The phenomenon has been studied in the test-taking context with the goal of determining its role in long-term retention and learning (Roediger & Bulter, 2010).

Evidence shows that retrieval practice (the process of retrieving information from your memory) plays a significant role in long-term retention and learning (Karpicke & Blunt, 2011; Roediger & Butler, 2011). The phenomenon has been studied in the test-taking context and findings provide overwhelming support to the fact that retrieval

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practice leads to a higher long-term retention of material than simply studying using more passive techniques. As Roediger and Butler (2011) state: "...testing, which is commonly conceptualized as an assessment tool, can be used as a learning tool as well" (p. 6).

Tools for Instructors

prepU generates class performance reports and displays these data on the *How's My Class Doing?* page. Data on this page include:

- a line graph showing students' overall mastery level and how it is changing as they take more practice quizzes
- the distribution of mastery levels among students
- students' overall usage of prepU
- students' strengths and weaknesses
- assignment results from assignments you have given them
- individual student usage information
- a selection of questions which reveal student misconceptions

Our data provides instructors with a wealth of information they can use in a formative way. That is, they can use real data from their students to see what's working and what isn't and where they need to focus additional instruction, practice, or remediation. And, importantly, this report is automatically generated and displayed for instructors each time they log in.

Tools for Students

On the *How am I Doing?* page, prepU provides the individual student user with a performance report including:

- a line graph showing overall mastery compared to the class average
- student specific strengths and weaknesses on the material
- performance on assignments vs. class performance
- bar graphs showing mastery level for each chapter, topic, and/or client need

Students see an array of informative data pinpointing their exact areas of strength and weakness and allowing them to make subsequent studying more efficient. They receive feedback as to where they need to spend more time studying and can compare their results not only to their own class, but also to a national pool of students.

How are Instructors and Students using prepU?

As part of our ongoing efficacy project we have been meeting with and collecting data from nursing instructors all across the country. The broader LWW/prepU Efficacy project seeks to gather information on student and instructor prepU usage as well as related student achievement data, to help determine the efficacy and impact of using prepU in nursing, health professions and NCLEX preparation courses.

prepU is designed to engage and motivate students and to encourage them to learn and master course content. The efficacy project is a way for us to connect with instructors and find out what's working for them and their students and also to see if we can measure the impact of prepU in a rigorous way. We have been working with instructors across multiple disciplines to help us build this body of evidence. Efficacy results are presented in a separate report. Here we present more practical guidance, based on how real prepU users are effectively implementing prepU into their courses and on questions they had at the outset.

prepU Features

To determine how best to weave prepU into your course or curriculum it's important to understand some of the key features of prepU:

Questions: Within the Question Library of prepU are hundreds or thousands of questions aligned to a particular book title, or to the NCLEX blueprint. There are many more questions than you would find perhaps in an end of chapter section, or "testbank" CD and all of the questions have actual difficulty data associated with them.

Question Calibration: All items used within an adaptive testing system must be calibrated. That is, we must collect performance data on the items prior to them counting towards a student's score. During a calibration phase students answer questions within prepU and performance data are gathered. Thus we have data on the percentage of students who get a particular question right or wrong. After a question has been answered at least 30 times, it is entered into the main question pool where student response data continues to be collected for the life of the question.

Difficulty Level: Question difficulty is not determined arbitrarily by the question author, but rather by analyzing the percentage of students who answer correctly and calculating the actual probability that a student will answer a question incorrectly. Many other quizzing systems make arbitrary decisions on how difficult items are, but it is impossible to make accurate predictions of difficulty just by looking at a question. Knowing the real difficulty of a question is an essential feature of any adaptive system.

Adaptive Quizzing: Adaptive testing is efficient and helps focus student learning on the right content. Within the adaptive quizzing area of prepU, a student's ability level is determined and continuously updated by their responses to calibrated items with known difficulty parameters. In prepU, the questions on a quiz are specifically chosen to motivate that student, and to maximize their potential in the most

efficient way. If students all see the same set of questions, many of those questions will be too easy or too difficult. In either case, the student will not be as motivated to practice and learn. Students will see questions around and just above their demonstrated level of mastery—the zone of proximal development.

Mastery Level: As students answer questions in prepU they achieve a "Mastery Level" on topics they have taken quizzes in. A Mastery Level (ML) is essentially a measure of the average difficulty level of the questions a student answers correctly. As a student answers more difficult questions correctly, s/he is given even more challenging questions on future quizzes. If these questions are answered correctly—allowing the student to demonstrate greater and greater mastery on course concepts, the student moves up in ML. The ML ranges from 1-8.

Why have Mastery Levels? If we didn't have mastery levels, students would only be looking at the percentage of given questions that they got correct. prepU is an adaptive quizzing system that builds quizzes that fall within a student's zone of proximal development, or area of need. Given the way prepU selects the questions for each student, an individual student score should typically be around 60% correct of the questions they are seeing.

Motivating Students: We want to motivate students. That's all. But we don't want them to equate their ML with a grade, since we don't make the grading decisions for their instructor and these vary tremendously. This is a crucial point. An A in one course at one school is very different from an A in another course at another school. We also can't benchmark the scores to a standardized exam, because there isn't one (except in the case of the NCLEX where we have been working on relating ML to NCLEX outcome).

Could a student's Mastery Level ever decrease? It could and here's why: Each chapter/topic/client need is independent since mastery of one doesn't necessarily indicate mastery of another. So if a student switches to a new chapter/topic they will start at ML 1 for that chapter.

This can make the overall ML go down, but only slightly because the overall ML is a weighted average based on the number of questions answered for each chapter. Since the student will have answered more questions on another chapter or topic, the associated ML factor into a student's overall ML far more heavily than the new chapter/topic.

Implementing prepU into your course

Instructors can implement prepU in different ways and each instructor has their own goals or reasons for using prepU. For example one instructor may wish to determine how much students know about a certain topic prior to the beginning the semester; others may wish to encourage students to read sections of the book before class; or they may want to encourage more evenly-spaced out exam preparation. Whatever your goals are—and we know that education is not a one-size-fits-all endeavor—you will find many ways in which prepU can help achieve these goals.

Getting Students Using prepU

prepU is easy to use and is a great way to help students practice and master course content. You can implement prepU in different ways, for example:
1. You can have students practice and take quizzes independently in prepU.
2. You can create assignments for your students to complete.

Of course, even if you create assignments, it is still important to encourage students to practice on their own. Creating assignments can help you address goals such as:

a) Encouraging reading of a book section/chapter before class
b) Determining specific areas of misunderstanding among students
c) Encouraging students to study for a test—but focus the studying on a particular set of questions.
d) Obtaining diagnostic information about what students know or don't know before instruction
e) Helping gauge how your class as a whole is performing on the same concepts.

There are two types of assignments in prepU and in both cases you can determine the number of points you would like each to be worth (and you can choose 0 if you want), set a time limit, set a due date, decide if students will be able to see the answer key after the assignment—or after the due date has passed.

Question Collection assignments: You can create assignments for your students from question collections. A question collection is essentially a separate folder into which you can drag and drop questions—similar to creating a music playlist from a larger music library. You can then assign this fixed-length assignment to your students. When you create a question collection assignment all of your students will answer the same set of questions—similar to a more "traditional" quiz.

Mastery Level assignments: With prepU's Mastery Level Assignments, you select the chapter or topic and set a ML goal (e.g., ML 3). prepU chooses the questions and generates quizzes for each student. To complete the assignment, students take individualized quizzes until they reach the ML you've required. ML assignments are an excellent tool to encourage your students to study more regularly—at their own pace. They also eliminate any risk of cheating—no two

students get the same quizzes. Important to note is that students will get different amounts of questions on these assignments.
The mastery level assignment allows you to assign credit for students based on whether they attain a level of mastery rather than giving credit based simply on completing a set number of questions. This method helps students to acquire mastery at the pace appropriate to the student.

If you decide to set a due date for an assignment, depending on your goals you could set the due date BEFORE lecture, thereby encouraging students to complete it before coming to class. Alternatively, you could have the due date be after instruction—in which case the assignment becomes more like a homework-type exercise.

Other ways instructors encourage students to use prepU include:

* Sharing some of the results and success stories we have found in other courses (see below)—in other words making sure students know that prepU really works! And that if they use it how we intend them to use it, prepU can help them succeed in both their course and on the NCLEX or other exams they may take.

*Telling students you will select a small number of questions for the midterm and /or final from prepU questions.

*Offering small amounts of course credit (see below for more on this).

Notes from the Field

An instructor wrote recently:

"I like prepU's mastery quizzes so much that I'm pondering using them for the pre-week assignment too (which is my encouragement for the students to read ahead of time).. For that, what I really want is a little reading check; something they can do after reading the chapter once. I was thinking of just setting a difficulty level of 2. Would that be appropriate?"

Yes, ML assignments are very appropriate for pre-lecture quizzing and indeed many instructors report using them for this purpose. Sometimes all it takes is a little encouragement from you to get students preparing for lecture ahead of time.

A ML of 2 is a good choice for a pre-lecture assignment. Some students will take longer than others to reach a ML of 3 (depending, of course, on the student and the topic) and so choosing 2 makes this assignment a little more manageable. Also, for a pre-lecture quiz, you want students to do what the instructor above calls a "reading check" but you don't necessarily expect students to have mastered most of the material already.

Notes from the Field

"Just wondering, do you know if profs who give assignments give extra credit for them? Straight credit doesn't seem fair, but I want them all to do it."

Credit for Quizzes

If you decide to give students credit for assignments or quizzing in prepU, smaller amounts are better. If you offer large amounts of course credit, students may start to find ways to "game the system". Of course this doesn't apply to everyone, but we have found that if the stakes are too high students might try and achieve a certain target in ways not conducive to effective learning.

Offering course credit for taking quizzes does tend to increase student participation—which is a good thing! Offering points for completion rather than a set criteria is one way to reward student participation and encourage the right use.

Offering students partial credit is another good option. For example if you are giving ML assignments, students could get 10 points for reaching a ML of 4, and 5 points for getting above a 1. In other words, students get credit for trying the assignment, even if they do not achieve the set ML criteria. It's important to have the lower ML threshold be above 1 because all students start at 1 and if you want to reward a level of usage above the bare minimum, you should set the lower requirement at a 2.

Important when giving credit for ML quizzes is to make sure to encourage students to keep practicing and taking quizzes even if they have achieved the criteria. We typically see a range of average MLevels around the 3-5 range. In schools and courses where ML quizzes are given with a set ML to attain (for example 3) we sometimes see all students reach the target of 3 and then stop quizzing.

Increasing engagement and building confidence
It can help students learn about prepU to give them an assignment, or have everyone take a quiz to essentially get their feet wet. Practicing in prepU not only helps build mastery of content, but many report to us that it helps some students alleviate test anxiety and get familiar with taking quizzes in a low-stakes environment.

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Notes from the Field

"Taking quizzes helps build my students' confidence...it can be the difference between success and non-success...if students are nervous they get anxious and might not read the questions properly. A big part of their NCLEX prep is mimicking the experience and that's what PassPoint does...."

How much are students using prepU?

We see a wide range of student usage of prepU. Usage depends on many factors such as the number of assignments in the course, level of encouragement from the instructor, and so on. Across our efficacy study analyses we see some instructors with average number of questions answered per student in the 5,000s and higher! Typically, however, the average student is answering between 800-1,000 questions in a nursing course although this increases as students begin to prepare for the NCLEX.

Interesting to note in many of our analyses is that up to the average number of questions answered (~800) prepU usage has a very strong positive relationship with course outcome. After that, the effect of additional prepU usage is still positive, but not as strong. This indicates that that prepU's benefit is optimal for the "average" user; not just the users who are answering far above the average number of questions.

The graph below illustrates this pattern nicely:

We can see here that up to ~1,000 questions there is a strong relationship between grade and usage. After that there is not much "added value"

Correlation between Number of Questions answered and Final Grade
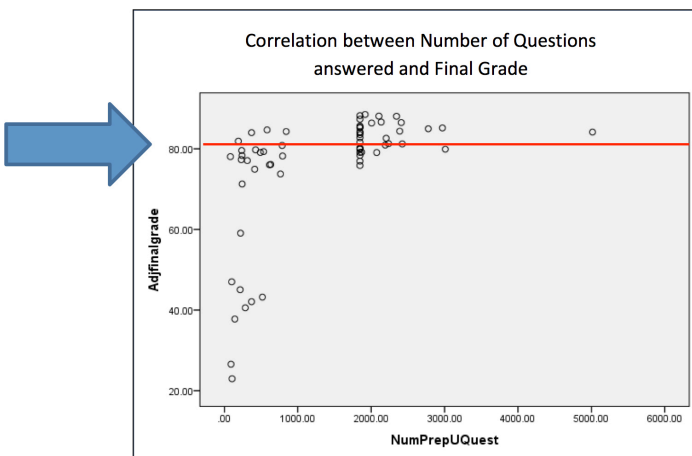
This is not to say that you should place a limit or maximum on student quizzing. Rather that in some cases we see a large variation in student usage leading to outlier situations. As all educators know, there will always be those students who work very, very hard but don't get the results you would expect, and others who don't put in much effort and who end up doing really well.

Timing

When assigning quizzes in prepU you have the option to provide students with a time-limit in which to complete the quiz. The feature is there to provide options for instructors, but in most cases they don't use time limits when students are engaged in assignments.

The reasoning is that prepU is a not a high-stakes testing environment. Nor does it measure skills where speed of performance is important. Rather prepU serves as a review and study tool to help students determine to which areas they should devote more study time, and if they need to adjust their thinking in any way. But in order for prepU to be effective, students must be encouraged to use prepU in the way it was intended.

The use of online quizzes to identify what one doesn't know and to study more in that area—a "prepare-gather feedback-re-study" is the exactly the use of prepU we would like to encourage. Results suggest that online quizzes should be used in concert with reading and studying, and not instead of. Imposing time limits on the quiz-taking may increase the likelihood that students use the quizzes in this way. Ultimately, however, it is crucial for students to see that studying, quizzing, receiving feedback, and studying more is by far the most effective way for them to master content

Retrieval Practice

The best way for students to prepare for a test is to practice with the same types of questions they'll get on the actual test. Ideally, students should use a range of assessments throughout a course to determine what they know and don't know. These assessments are most effective when they resemble the exams used in the course.

Clarifying Mastery Levels for your Students

When a student uses prepU for the first time, or for a new chapter or topic, they start at a ML of 1. This means that the questions they will be seeing on the quizzes are at a difficulty level of around 15 +/- 5. A question of this difficulty level is answered, on average, incorrectly by about 15% of students. So it's a relatively easy question. If students do well and start answering questions at the higher end of the difficulty range they will "graduate to ML 2 and see more difficult questions...and so on. No one should expect to get 100% of

the questions right all the time. The key is to keep students motivated to reach higher levels (like progressing in a video game), with quizzes that are neither too difficult (frustrating!) or too easy (boring!)

Relating mastery level to the difficulty of the questions is the best way to go in terms of helping students understand the idea. We can also provide information about how ML relates to a student's relative position in the class, but it is likely sufficient to go with difficulty.

Many instructors and students ask if the mastery levels in prepU correspond to a particular grade level—in other words, can they say with any confidence that if a student achieves a prepU mastery level of 3 they are likely to get a B in the course (for example)?

Notes from the Field

An instructor wrote recently:

"The main question I have for you right now is what do the different mastery levels mean? I remember talking with you about this on the phone and you suggesting a level of 3 or so for a quiz like this, but I guess I'm wondering just how hard it is to get up to a 4/5/6. What would be good level where I could say "If you can get to this level, you'll do well on the exam", and what can I tell the students that the various levels mean?"

It is, of course, impossible, on a global basis, to provide information equating mastery level with a grade because grading criteria vary widely between different institutions as do the student populations. As mentioned above, a grade in one course with one instructor is not necessarily the same as a grade in another course with another instructor—or at another institution. There are, however, opportunities within individual courses for us to examine such patterns and we have been doing just that in our efficacy studies.

Mastery Level Predictions

Research conducted as part of our on-going efficacy project is helping us demonstrate the predictive power of prepU. Using linear regression analyses we have analyzed data from multiple nursing courses and found that ML can be used to predict one or more course outcomes. In other words, looking at a student's prepU mastery level can help an instructor better determine if a student will do well in the course.

Regression analysis can be used to predict the value of one variable based on another. For example, the independent (or predictor) variable (mastery level) could be used to predict the dependent (or outcome) variable (final exam score, or course grade).

Overwhelming we find that students who use prepU and achieve a high level of mastery across a wide breadth of topics are more likely to do better in their courses.

And more than that—we have shown that mastery level can be used to predict student outcome. So encouraging your students to practice in prepU and increase their mastery is proven to increase their likelihood of doing well in your course.

If you are new to using prepU we can work with you to collect and analyze your own course data. By exploring the relationship between prepU usage and student outcomes, we can begin to help answer the question posed by the instructor above—"what do the different mastery levels mean?"

Mastery Level Predictions and NCLEX

We have also been analyzing the relationship between the average ML of students who passed the NCLEX and also used prepU in a meaningful way. Those students who passed the NCLEX and used prepU had an average Mastery Level of 3.93 and ML was significantly positively correlated with the number of questions students answered in prepU as well.

Notes from the Field

"What is the average number of questions that our students undertake in a given chapter to reach a mastery level of 3 in the PN program and 4 in the RN program?

What is the average time to reach those levels?"

Mastery Level vs. Questions Answered

When we have used the number of questions as the predictor variable the regression was either not significant, or was significant but with a smaller effect size. Thus we see that ML in prepU can be used, in the course data analyzed, to predict a student's final exam score/grade level group etc. In some cases the number of questions answered in prepU could also be used to predict student outcome but the effect size was smaller than for mastery level.

In an adaptive-quizzing environment the most important outcome is not the number of questions a student answers, but rather the mastery level attained. Our results support the hypothesis that ML is a better predictor of final grade than number of questions answered. This finding supports the underlying principles of adaptive quizzing which are that quizzing is meant to be efficient and help focus the student learning on the right content. In doing so, some students will need to answer more questions than others to reach the higher mastery levels.