

White Paper

An Investigation of Student Use of prepU and NCLEX Success

by Dr. Julia Phelan, National Center for Research on Evaluation, Standards, and Student Testing, University of California-Los Angeles

INTRODUCTION

Combining a formative assessment tool for instructors and an online quizzing and learning environment for students, prepU brings together best practices in learning, technology and assessment to provide a unique adaptive quizzing tool for students and instructors. Online quizzing allows students to study and learn using the mastery approach proposed by Bloom (1968). By allowing students to take quizzes, study, retake quizzes, study again and so on, students may benefit from some of the learning gains shown in mastery learning programs (Kulik, Kulik, & Bangert-Drowns, 1990).

Research also supports the idea 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 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).

prepU provides opportunities for students to reap the benefits of retrieval practice and frequent quizzing during their coursework and also while preparing for high-stakes exams. To help us better understand the use and impact of prepU we created the Lippincott Williams and Wilkins/prepU Efficacy Project.

SUMMARY

- Compared to the national NCLEX passing average (87.89%), students who reported using prepU during their final semester at nursing school had a 98.7% pass rate.
- Students who used prepU both during their course and afterwards to study for the NCLEX had an average of 104 questions on the NCLEX, compared to the national average of 121.
- Average prepU mastery level for students who used prepU and passed the NCLEX was 3.93.
- The findings from this study support our classroom data for textbook prepU versions which clearly demonstrate that progression through prepU mastery levels leads to better student outcomes (grades or NCLEX pass rates).



What is the Lippincott Williams and Wilkins/prepU Efficacy Project?

The Efficacy Project is a multi-pronged research approach designed to:

- gather qualitative and quantitative information on student and instructor usage of prepU
- explore the relationships between student achievement, prepU usage and content mastery
- help determine the efficacy and impact of using prepU in nursing and NCLEX preparation courses
- explore different use cases of prepU
- analyze the significance and accuracy of predictions based on prepU variables and student performance outcomes

The following summarizes findings from two studies—within the larger efficacy work—investigating prepU usage in students preparing for the NCLEX. We were interested in exploring students' usage of prepU as they prepared to sit for the NCLEX and also investigating the relationship between prepU usage, content mastery and students' ultimate success on the NCLEX exam.

About 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.

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. As students answer questions in prepU they achieve a "Mastery Level" on topics they have taken quizzes in. A Mastery Level 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—

A Mastery Level is essentially a measure of the average difficulty level of the questions a student answers correctly

allowing the student to demonstrate greater and greater mastery on course concepts, the student moves up in Mastery Level.

Within prepU, the questions on a quiz are specifically chosen to motivate the 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. prepU is not designed to push students through the system as quickly as possible, but rather to motivate and help students master the content they need to learn. prepU provides an environment in which students can practice and improve and can compare their performance to thousands of other prepU users across the country.

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 & Butler, 2010).

Evidence of the Impact of prepU

Many early efficacy trials and case studies have been conducted with instructors using prepU in both nursing and biology. For example, in a randomized, controlled study of approximately 200 students in a majors biology course, learning gains of students who used prepU were 62% greater than the learning gains of students who did not (Phelan & Phelan, 2011). Learning gains were measured by the student's ability to answer validated questions from the GRE, the MCAT, and state test released items. In another biology course, the system was used by 309 students and analyses indicated a strong, positive relationship between use of prepU and mastery of the course content. Furthermore, students who answered more questions in prepU were more likely to have a higher class ranking and score more points in the class overall (Phelan, 2012). In another study, students in a second-semester Psychiatric Mental Health course received access to prepU for the last four weeks of the semester. A comparison of average exam scores on the exams given before prepU was available to those taken after prepU was available, revealed a significant increase in performance. In other words, the average scores on the course outcomes increased significantly after prepU was available and students were using it (Phelan & Smith, 2012).

About the NCLEX

Upon graduation from nursing school, graduates must pass the National Council Licensure Examination for Registered Nurses (NCLEX-RN) before becoming a licensed nurse. The NCLEX-RN (from now on referred to as NCLEX) exam is a variable length CAT anywhere from 75 to 265 items long. Of the items presented 15 are pretest (calibration) items that are not scored. The time limit for the exam is six hours (maximum), and the length of the exam is determined by the candidate's responses to the items. After the minimum number of items (75) has been answered, testing stops when either a) the candidate's ability is determined to be either above or below the passing standard with 95% certainty, or b) the examination maximum number of items has been answered, or c) the time limit has been reached. The National Council of State Boards of Nursing (NCSBN) reports that the average number of questions for the NCLEX (in 2009) was 121, and the average length of the exam was 2.5 hours. Only about 2% of test takers run out of time and this statistic has been consistent since 2005 (NCSBN).

Many accrediting bodies have included in the accreditation process the first time NCLEX pass rate (Holstein, et al., 2006). Thus, the percentage of students passing the NCLEX the first time has come to be seen as one indicator of a successful nursing program. Data also indicates that second-time test takers are less likely to pass than first-time test takers, with a longer lag time between graduation and taking the exam associated with lower pass rates (NCSBN, 2002). These statistics are yet another incentive for nursing programs to adequately prepare students to pass the NCLEX—on the first try. Larger numbers of failing students may have detrimental effects on how others view the quality of a nursing program as well as continuing accreditation.

Not surprisingly, nursing programs are interested in making sure that their graduates are all passing the NCLEX the first time, but also likely to be hesitant to graduate students for whom success on the NCLEX is questionable. This phenomenon creates problems for a studies of predictors of success as there is little variance in success once students have graduated from nursing school. By the time students have graduated and take the NCLEX, the likelihood they will pass is very high. Indeed, the percentage pass rate of first-time test takers from US nursing schools is 91.23% for 2012 so far (NCSBN, 2012).

The Study: Sample & Design

As part of the broader, multi-pronged efficacy project investigating prepU usage and subsequent impact on student learning outcomes and teaching practices, we conducted two, exploratory NCLEX-related studies. Study 1 utilized a survey design to obtain information from recent nursing graduates who were given access to prepU during their final semester of nursing school. This access was during a trial period

when the prepU NCLEX 10,000 product was being class-tested. Study 2 is nested in the broader efficacy work and reports on retrospective case-study investigations of two different use cases of prepU in an NCLEX review-course environment.

Study 1: Sample and Design.

For Study 1 an email survey was sent to all students who participated in a trial of the NCLEX 10,000 prepU product, and who consented to be contacted. The survey contained six questions pertaining to graduation date, NCLEX test date, number of NCLEX questions answered, NCLEX result, and use of prepU to help prepare for the NCLEX. The email survey was sent out in the summer of 2011 with the intent of surveying students who had recently graduated and taken the NCLEX.

Student responses (N = 223) were analyzed to explore the relationship between use of prepU and self-reported score on the NCLEX exam. This analysis provided information on how prepU usage related to NCLEX pass rate and/or number of questions answered. We also explored feedback provided by those students who reported using prepU to prepare for the NCLEX exam, and provided details on their experiences doing so.

Study 2: Sample and Design.

Study 2 combined data from two instructors (A and B) each with two classes (N = 89), from two universities. The study group included students who completed NCLEX review courses as part of their senior year in nursing school, and who had access to prepU as an additional resource, or part of the course requirements.

The study sample was a sub-set of a larger group, and were selected as they took ATI predictor tests as a course requirement. We included the ATI Predictor data so we could compare prepU mastery, ATI predictions and final NCLEX outcomes. The ATI Predictors results are theoretically used to help make predictions about student success on the NCLEX. The study sample included students who graduated in both fall, 2011 and spring, 2012.

Instructor A teaches Clinical Decision Making as part of the final semester of the nursing curriculum. The course has no lecture component and is made up of small-group presentations. Students create lessons on areas where they feel they need help and the goal is that they teach each other. Instructor A used prepU specifically to help students identify areas where they needed help, and where they could better focus their studying. Students are required to answer a minimum number of questions in prepU each week.

Instructor B teaches both a senior course to help students prepare for the NCLEX and a fundamentals course for third-semester students. In the NCLEX course, Instructor B made use of prepU optional for the students, although use was encouraged prior to each predictor test taken. Instructor B guided her students towards areas to focus on for their continued NCLEX studying after they graduated.

prepU usage and Mastery Level data as well as course performance data were collected. Instructors also reported the pass/fail rates on the NCLEX for each student as they became available. In some cases, instructors were able to obtain the number of questions answered on the NCLEX, but this was not so for all students.

Study 1: Findings. prepU usage and Mastery

Level for Study 1 participants is shown in Table 1. The average number of questions answered in prepU was 693.06 and the average Mastery Level 2.93.

Of the 223 students in the sample, some had not used prepU in a meaningful way and were excluded from the analysis. Exclusion was typically a result of not logging in to prepU at all, or not answering any questions in the system. The resulting sample (N = 182) included students who had achieved at least a Mastery Level >1. Of these 182 students, 98.9% (180 students) reported success on the NCLEX (the number was the same for the larger sample as well).

A prepU Mastery Level of 1 is the bare minimum possible for a prepU user and so we also analyzed data for those students who had a Mastery Level > 2 (N = 149). For this group the percentage achieving

NCLEX success was 98.7%, with an average number of questions on the NCLEX of 99.62 (ranging from 75-265) and average prepU Mastery Level of 3.93 (see Table 2).

Frequency of scores for this group indicated that 62.4% of students (N = 93) reported answering exactly 75 questions on the NCLEX, 6% reported answering 265 questions and the rest fell in between. Of the students with a ML >2, 66% reported that they used prepU to help them prepare for the NCLEX (post-graduation) and for this group the average ML was 3.9. Some students reported not knowing that they still had access to prepU following graduation. Given the trial basis of the student and instructor prepU usage for this group, it was not surprising that some students did not have access to prepU after graduation, or they did not know they had access. Many of that group reported that prepU was an essential tool for them to pass their HESI exit exams prior to graduation from their nursing program.

A Pearson product-moment correlation coefficient was computed to assess the relationship between prepU Mastery Level and all other prepU usage variables. There were significant positive correlations between all variables (see Table 3).

Table 1: Study 1, Student prepU Usage

	N	Minimum	Maximum	Mean	Std.Deviation
Log Ins	223	1.00	118.00	20.06	18.65
# PrepU Quizzes	223	0.00	286.00	44.78	48.63
# PrepU Questions	223	0.00	4530.00	693.06	688.21
Mastery Level	223	0.00	8.00	2.93	1.90

Table 2: Study 1, Student prepU Usage if ML > 2

	N	Minimum	Maximum	Mean	Std.Deviation
Log Ins	149	2.00	118.00	25.27	18.32
# PrepU Quizzes	149	7.00	286.00	59.73	51.05
# PrepU Questions	149	105.00	4530.00	909.19	716.80
Mastery Level	149	2.10	8.00	3.93	1.45
Valid N (listwise)	149	-	-	-	-

Study 2: Findings.

Study 2 focused on students' use of prepU in courses with one of two instructors both of whom had incorporated prepU into their course, albeit in different ways. Of the 62 students for whom we received NCLEX data, 61 students (98.4%) passed and one failed. To date, 27 of the students in the sample have not yet taken the NCLEX, or have not yet reported back to their instructor. prepU usage data for the NCLEX takers is shown in Table 4. Of the group who took the NCLEX so far, the average number of log-ins to prepU was 42.13, the average number of questions answered 1,258.25 and the average Mastery Level 5.26.

For a small subset of students we received information on the number of NCLEX questions answered. For this sub-group (N = 12) the average number of questions was 101.92 (lower than the national average of 121).

For 73 students in the sample, we received data on probability of passing the NCLEX as determined by their ATI predictor scores (see Table 5). For this group of 73 students, the average probability of passing the NCLEX, as determined by scores on the ATI predictor tests was 76.82% (SD = 17.6%).

Forty-six of the students for whom we have ATI data reported NCLEX results (as of August, 2012). Of this group, 44/46 (95.6%) indicated that they used prepU to help prepare for the exam (see Table 6).

Only one of the students represented in Table 6 failed the NCLEX although the average probability of passing (based on the final predictor scores) was 74%. The actual passing rate for students with predictor data was 97.8% compared to the average of 74% reported by the ATI predictors (the range was from 19% to 98%). Thus the ATI predictors seem to be greatly under-estimating pass rates by giving a higher than is warranted number of false-negative predictions. This means that all the students predicted to be likely to pass indeed do

Table 3: Study 1, Within prepU Correlations

	N	Minimum	Maximum	Mean	Std. Deviation
Log Ins	149	2.00	118.00	25.27	18.32
# PrepU Quizzes	149	7.00	286.00	59.73	51.05
# PrepU Questions	149	105.00	4530.00	909.19	716.80
Mastery Level	149	2.10	8.00	3.93	1.45
Valid N (listwise)	149	-	-	-	-

**Correlation is significant at the 0.01 level (2-tailed).

Table 4: Study 2, Student prepU Usage Data for NCLEX Takers

	N	Minimum	Maximum	Mean	Std. Deviation
Final Predictor %	14	0.63	0.98	0.84	0.11
# Log Ins	60	2.00	89.00	42.13	21.16
# Quizzes	60	3.00	777.00	134.55	108.01
# Questions	60	15.00	3747.00	1258.25	615.25
Mastery Level	60	2.00	8.00	5.27	1.20

Table 4: Study 2, Student prepU Usage Data for NCLEX Takers

	N	Minimum	Maximum	Mean	Std. Deviation
# Log Ins	69	1.00	265.00	65.33	53.70
# of Quizzes	69	0.00	777.00	100.74	118.55
# Questions	69	0.00	3747.00	940.87	813.62
Mastery Level	60	1.00	8.00	4.78	1.91
Probability of Passing NCLEX	73	0.19	0.99	0.77	0.18

pass, but a group who were predicted to be less-likely to pass, ended up passing as well. The ability to predict success with higher accuracy than failure is consistent with other research conducted on myriad possible NCLEX predictors (see for example Alexander & Brophy, 1997; Seldomridge and Di Bartolo, 2004) and underscores the pervasive problem of determining how to best predict success on the NCLEX exam using available data.

For the 62 students who have reported their NCLEX scores, we analyzed the correlation between the prepU usage and Mastery Level (note two of these students did not use prepU). The analysis revealed a significant, positive correlation between all prepU usage variables and prepU Mastery Level (see Table 7).

Table 6: Study 2, prepU Usage ATI Prediction (for prepU users who have taken the NCLEX)

	N	Minimum	Maximum	Mean	Std. Deviation
# Log Ins	44	2.00	89.00	45.39	22.82
# of Quizzes	44	3.00	777.00	151.57	121.31
# Questions	44	15.00	3747.00	1386.20	665.46
Mastery Level	44	2.00	8.00	5.50	1.26
Overall probability of passing the NCLEX	46	0.19	0.98	0.74	0.18

Limitations

The two studies reported here were somewhat limited in terms of the size of the samples, the amount of complete data available for each student, and the self-report nature of reporting of NCLEX pass rates. These limitations, however, are not unique in the nursing domain and in all similar studies we reviewed sample sizes tended to be similarly small. Indeed, in most of the senior-level nursing courses included in the broader efficacy study, class size tends to be between 18-25 students and larger sample sizes are less common. Furthermore in studies looking at similar student outcomes, NCLEX success data were self-reported via surveys sent directly to schools.

Generalizability of the findings may also be affected by potential differences in schools, curricula, content of courses, grading practices, student demographics and so on. We continue to collect more data and design and implement additional studies in ongoing efforts to address the above issues and further explore the efficacy of prepU with a larger representative sample.

Conclusions, Implications and Next Steps

Findings from both studies reported here are promising and confirm previous trends relating to usage and student outcomes in other subject areas (Phelan & Phelan, 2011). In these studies, however, we typically have access to course-level data (midterms, final exams, final grades etc.) and so are able to perform analyses investigating the

relationship between use of prepU, Mastery Level and course outcomes. The primary tool we use to generate predictions about student outcomes based on prepU performance is regression analysis. This is a technique that helps us to identify the relationship between a dependent variable (performance on an exam, or grade in the course, for example) and one or more independent variables (final Mastery Level, number of quizzes taken, etc.). We can then estimate a student's performance based on their Mastery Level or one of the other variables.

In the NCLEX review courses we studied, this type of analysis was not possible as all the courses were graded on a pass/fail basis and almost all students pass the courses. Therefore, as with the NCLEX itself, there is little or no variation in student outcomes rendering it impossible to make such predictions.

Operating within these constraints we explored the relationship between usage of prepU—in multiple contexts—and subsequent success on the NCLEX. In Study 1, results indicated that students who used prepU during their final semester at nursing school had a higher (98.7%) NCLEX pass rate compared to the national NCLEX passing average (87.89%). Of the students who responded to the survey, 65.8% continued to use prepU after graduation to help prepare for the NCLEX. Many who did not use prepU reported that they didn't have access after graduation, or did not realize that they did.

Table 7: Study 2, Within prepU Correlations

		Z score: Log Ins	Z score: # PrepU Quizzes	Z score: # PrepU Questions	Z score: Mastery Level
Z score (Log Ins)	Pearson Correlation	1	.603**	.809**	.506**
	Sig. (2-tailed)		.000	.000	.000
	N	60	60	60	60
Z score: # PrepU Quizzes	Pearson Correlation	.603**	1	.872**	.565**
	Sig. (2-tailed)			.000	.000
	N		60	60	60
Z score: # PrepU Questions	Pearson Correlation			1	.628**
	Sig. (2-tailed)				.000
	N			60	60
Z score: Mastery Level	Pearson Correlation				1
	Sig. (2-tailed)				
	N				60

Correlation is significant at the 0.01 level (2-tailed).

The NCLEX is a pass/fail exam—with no reported numerical score. The only variable a student does know after taking the test is how many questions they answered before a decision was made. We were interested in comparing the number of NCLEX questions each student answered to final NCLEX outcome and prepU usage. A reasonable hypothesis is that well-prepared students are more likely to pass the exam with fewer questions than are less well-prepared students, although there are no known empirical studies supporting this idea.

Results indicated that students who reported using prepU both during their course and afterwards to study for the NCLEX answered an average of 104 questions on the NCLEX, compared to the national average of 121. In the absence of other information on the relationship of student performance to the number of questions answered on the NCLEX, we cannot draw conclusions from these data. Some students, however, have reported that once they have answered 75 questions, if the NCLEX system continues to give them more questions, they have decreasing confidence that they will pass the exam. A student receives more than 75 questions (the minimum) if the computer is not 95% confident that the student is at or above the passing standard. Further exploration is needed to study this relationship.

prepU Mastery Level has been shown in many of our other studies to significantly predict course outcomes such as number of total course points, or final grade (see Phelan & Smith, 2012; Phelan & Orm, 2012;

Phelan and Phelan, 2012; Phelan & Phelan, 2011). In the current study we analyzed the relationship between the average Mastery Level of those 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 Mastery Level was significantly positively correlated with the number of questions students answered in prepU.

Given the previously observed strong relationship between Mastery Level and student outcomes (including some of the students in the current studies), we created groups of students based on final prepU Mastery Level. For those students who both took the NCLEX exam and had at least a Mastery Level of 2, the average number of questions answered on the NCLEX was 99.62, even further below the national average of 121. In addition, 62.4% of students in this group reported passing the NCLEX with exactly 75 questions—a potential indicator of higher levels of content mastery.

In Study 2 we combined prepU data with course outcome data (such as ATI predictors) for four classes of students using prepU as part of their nursing program course requirements. Findings indicated that scores on ATI predictor tests did not accurately predict student pass rates on the NCLEX—with many more students predicted to fail than actually did so. Of the 62 students for whom we received NCLEX data, 61 students (98.4%) passed and one failed.

Usage and Mastery Level in prepU was high for the group of NCLEX takers: the average number of log-ins to prepU was 42.13, the average number of questions 1,258.25 and the average Mastery Level 5.26. By way of comparison, in the larger sample of students in Study 1, the average number of log-ins was 20, average number of questions 693.06 and the average Mastery Level 2.93.

prepU usage was also positively correlated with prepU Mastery level indicating as student usage of prepU increased, so did the difficulty of questions they answered correctly.

The above mentioned studies reflect early efforts to better understand student use of prepU to help prepare for the NCLEX and also the impact of usage on NCLEX success. As discussed earlier, the nature of the NCLEX data (pass/fail) and the high percentage of students passing the NCLEX on their first try renders analysis complex as there is little or no variation in student outcomes. Future endeavors will focus on securing more detailed data from students and faculty about NCLEX question numbers, pass rates, and prior student course performance. This information may help better predict students at-risk for failing the NCLEX and provide more insight into factors which may predict success. We will also continue to explore the extent to which prepU usage influences student learning, mastery of course material, and ultimately student success on the NCLEX.

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Dr. Julia Phelan is a senior researcher at the UCLA Center for the Study of Evaluation, Standards and Student Testing. She has over 12 years of experience in curriculum and assessment development, research design and implementation and has directed several large-scale assessment and evaluation projects. Dr. Phelan serves as an assessment expert and research consultant for Macmillan/New Ventures (parent company of prepU) and also guides research and evaluation efforts at Wolters Kluwer Health/Lippincott Williams and Wilkins. She is married to Dr. Jay Phelan who teaches biology at UCLA, is the author of the bestselling textbook What is Life? and who co-created prepU. All results obtained from the analyses are reported—nothing has been excluded. The findings reported here are representative of our commitment to objectivity in our study of the efficacy and ongoing use of prepU.