COURSE SUCCESS

LIPPINCOTT FOR LIFE

Case Study

Higher Mastery Predicting Course Outcomes

Connie Houser, MS, RNC-OB, CNE

Central Carolina Technical College
Nursing Fundamentals | Spring 2012

SUMMARY OF FINDINGS

- **prepU was used in Nursing Fundamentals 101 both as an independent study tool for students and also as an integrated part of the course.**
- **The current study found that prepU Mastery Level was significantly, positively correlated with the number of questions answered in prepU, as well as with final course outcomes**
- **A regression analysis established that prepU Mastery Level could be used to predict the final exam score, and also the final number of points in the course.**

Course

Nursing fundamentals (Nursing 101) is a course for first year nursing students. During spring 2012, 65 students attended and used the *Taylor, Fundamentals of Nursing* textbook along with the adaptive quizzing tool, prepU. prepU usage data along with course performance data were available for 65 students and 61 students completed all course requirements.

Course Grading Policies and Assessment

Course grades were determined by:

- Five mid-course exams and one final for 90% of theory grade
- Ten points earned via quizzes (paper/pencil and prepU with at least a Mastery Level of 3)
- Grades assigned as follows: below 75 F, 75-80 C, 81-90 B, 91-100 A .

prepU Implementation

All students were given access to prepU and are encouraged to use it throughout the course to gain extra practice and help master course concepts. A small number of points (10) were awarded to students who completed a set number of quizzes (on Chapters 1 and 8) and also for achieving a mas-

Wolters Kluwer Health

tery level of 3 on the nursing process chapters. This was to introduce them to prepU and encourage them to try it. After that, most of them just moved forward on their own.

Results

prepU usage data from 65 students is shown in Table 1. Students answered an average of 1,280 questions and took an average of 110 quizzes. The average mastery level attained by the study sample was 3.66.

Table 1: prepU Usage Data

	N	Min	Max	M	SD
Number of Quizzes	65	5.00	375.00	110.26	89.54
Number of Questions	65	42.00	4935.00	1280.06	1077.08

Course Outcomes

Course outcome data for the 65 students in the course is presented in Table 2. These data include the total number of points earned (M = 431.78, SD = 56.38) and scores on each of the five course exams.

Table 2: Course outcome data (N = 65)

	N	Min	Max	M	SD
Exam 1	65	54.00	90.00	78.15	6.51
Exam 2	65	66.00	96.00	82.49	6.26
Exam 3	65	64.00	92.00	78.61	6.87
Exam 4	65	72.00	92.00	81.35	5.52
Exam 5	62	70.00	92.00	84.45	4.93
Final Exam	61	71.00	90.00	80.87	4.59
Final Grade	65	51.35	88.50	79.82	7.17

Note: The data for number of questions and mastery level had a degree of positive skewness, so these data were transformed using a Log10 transformation to better fit the normal distribution requirements of the linear regression model.

Frequency of Grades

The frequency of final letter grades is shown in Table 3. Of the 64 students in the course, 8 students received an F, 19 students a C, and 37 students a B. The cut-off for earning an A grade in this course was 91 and the highest-scoring student achieved 88.5 (see Table 2). Thus, there were no A grades earned in this group.

Table 3: Letter grade Frequency

		Frequency	Percent
	F	8	12.5
	C	19	29.7
	B	37	57.8
	Total	64	100.0

An analysis of correlations between student course outcomes (including final class rank and total points) and student usage of the online assessment tools (including number of questions answered and mastery level) revealed significant findings across all comparisons (see Table 4).

Table 4: Correlations between course outcomes and student prepU usage

		Number of Questions	Mastery Level	Final Exam	Final Grade
Number of Questions	Pearson Correlation	1	.763**	.130	.099
	Sig. (2-tailed)		.000	.317	.432
	N		65	61	65
Mastery Level	Pearson Correlation		1	.294*	.193
	Sig. (2-tailed)			.022	.123
	N			61	65
Final Exam	Pearson Correlation			1	.686**
	Sig. (2-tailed)				.000
	N				61
Final Grade	Pearson Correlation				1
	Sig. (2-tailed)				
	N				

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

*. Correlation is significant at the 0.05 level (2-tailed).

Of the 64 students in the course, 3 did not take the final exam. The subsequent analyses focus on the group who did take the final exam and satisfied all course requirements (N = 61). Table 5 presents overall prepU usage for the group who completed all course requirements and Table 6 presents course outcomes.

Table 5: Overall prepU Usage for Final Exam Group					
	N	Min	Max	M	SD
Number of Quizzes	61	5.00	369.00	109.21	84.57
Number of Questions	61	42.00	4260.00	1254.83	992.37
Mastery Level	61	1.60	7.70	3.67	1.31

Table 6: Course Outcomes for the Final Exam Group					
	N	Min	Max	M	SD
Exam 1	61	54.00	90.00	78.39	6.60
Exam 2	61	68.00	96.00	82.92	5.96
Exam 3	61	64.00	92.00	78.75	6.87
Exam 4	61	72.00	92.00	81.64	5.52
Exam 5	61	70.00	92.00	84.52	4.94
Final Exam	61	71.00	90.00	80.87	4.60
Final Grade	61	71.60	88.50	81.39	3.63

Correlations between prepU usage and final course outcomes are shown below in Table 7. A Pearson correlation revealed a significant positive correlation between mastery level (ML) and number of questions answered, as well as ML and final exam and final points (see Table 7).

Table 7: prepU Usage and Final Course Outcome Descriptive Statistics for final exam group

		Number of Questions	Mastery Level	Final Exam	Final Grade
Number of Questions	Pearson Correlation	1	.753**	.137	.156
	Sig. (2-tailed)		.000	.298	.235
	N		60	60	60
Mastery Level	Pearson Correlation		1	.327*	.354**
	Sig. (2-tailed)			.011	.006
	N			60	60
Final Exam	Pearson Correlation			1	.688**
	Sig. (2-tailed)				.000
	N				60
Final Grade	Pearson Correlation				1
	Sig. (2-tailed)				
	N				

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

*. Correlation is significant at the 0.05 level (2-tailed).

Regression Analysis
Mastery Level and Final Exam Score

A linear regression established that final prepU ML could statistically significantly predict scores on the final exam given in this course, $F(1,59) = 5.570$, $p < .05$. Final prepU ML accounted for 7.1% of the explained variability in final exam score, which is a small/medium effect size according to Cohen's (1988) classification. The regression equation was: predicted final exam score = 76.027 + 8.977 x (ML_Log10).

The predicted score on the final exam can be calculated by inserting different mastery levels into the regression equation. For example, a student with a mastery level of 6 would be predicted to receive 83.01 points on the final exam (see Table 8 for a complete list of predicted total points based on this analysis). Mastery levels were transformed into log10 to better fit the regression parameters of normality.

Table 8: Predicted final exam score based on mastery level	
ML	Predicted Final Exam Score
1	76.03
2	78.73
3	80.31
4	81.43
5	82.30
6	83.01
7	83.61
8	84.13

The average ML for this group was 3.67. When this number is inserted into the regression equation, the predicted final exam score is 81.10, which falls within the B range for the course (when considering how grades are assigned for all exams).

Mastery Level and Final Grade

A linear regression established that final prepU ML could statistically significantly predict students final grade in this course, $F(1,58) = 8.285$, $p < .01$. Final prepU ML accounted for 11% of the explained variability in final grade which is a medium effect size according to Cohen's (1988) classification. The regression equation was: predicted final grade = 77.204 + 8.108 x (ML_Log10).

The predicted final grade can be calculated by inserting different mastery levels into the regression equation. For example, a student with a mastery level of 6, would be predicted to receive 83.51 overall points for the course (see Table 9 for a complete list of predicted total points based on this analysis). Mastery levels were transformed into log10 to better fit the regression parameters of normality.

Table 9: Predicted final grade (points) based on mastery level	
ML	Predicted Final Grade (points)
1	77.20
2	79.64
3	81.07
4	82.09
5	82.87
6	83.51
7	84.06
8	84.53

The average ML for this group was 3.64 (one outlier was removed to satisfy the assumptions of the regression model). When this number is inserted into the regression equation, the predicted final exam score is 81.75, which falls within the B range for the course.

A linear regression analysis looking at the predictability of number of questions and final grade (and also final exam score) was not significant. Thus mastery level was the best (prepU-related) predictor of success in the course.

Table 10 presents a comparison of prepU usage between spring 2011, fall 2011, and spring 2012. The average number of questions answered by the students in the course previously had increased by 78%. For the spring 2012 cohort, usage remained similar to the fall 2011 cohort.

Table 10: Comparison of prepU Usage			
Semester	**Average # Questions**	**Average # Quizzes**	**Total # Questions**
Spring, 2011	785	71.7	51,838
Fall, 2011	1,291	127.3	91, 664
Spring, 2012	1,254	109	83,204

Conclusion

prepU was used in Nursing Fundamentals 101 both as an independent study tool for students and also as an integrated part of the course (with results from several quizzes making up a portion of the final grade). This current study followed two other studies completed with the spring and fall cohorts of the same course in which we found a positive relationship between the number of questions answered within prepU and final exam score.

The current study found that prepU mastery level was significantly, positively correlated with the number of questions answered in prepU, along with final course outcomes (final exam score and final points). The number of questions answered, however, was not significantly correlated with final course outcomes. In an adaptive-testing environment the most important variable to consider is usually not the number of questions a student answers, but rather the mastery level attained. Therefore this finding indicates that most important to student success is content mastery rather than sheer volume of questions. A regression analysis established that prepU mastery level could be used to predict the final exam score, in addition to the final number of points in the course.

There are, of course, many unknowns in a study such as this one. Individual differences between students play a large role in student performance and there is no pretest data against which to measure growth or change. In addition, as any instructor will tell you, there will always be students who achieve a high grade without seeming to put in much effort and those who apply themselves with serious effort who somehow don't make the grade. Many educational interventions seek to focus on those students somewhere in-between the two extremes; in other words, those who are perhaps within reach of achieving something more, if only they had some more motivation or some extra help. The evidence suggests that prepU is particularly advantageous to these students. These results, along with others, indicate that prepU's benefit is optimal for the "average" user, not just the users who are answering far above the average number of questions one might expect them to answer.

Student feedback was overwhelmingly positive—although only a small percentage of students responded to the survey. This is not unusual as there is frequently little

incentive for students to complete surveys once they have completed a course and are away from school for the summer.

Professor Houser has been using prepU as part of her course requirements for about two years. Usage in Professor Houser's courses has increased from when she was first using it in her fundamentals course, although usage is lower in some of the smaller, senior-level courses she teaches.In her interview comments (Appendix A), Professor Houser reported that she still has not yet "determined the 'perfect' mastery level to have students achieve, so I encourage them to do many questions."

Results from this course indicate that as mastery level increases, students are likely to receive a higher course grade. Of course, the number of questions students answer and the number of topics on which they answer questions play a role in this as well; more questions and content coverage and higher overall mastery level are all indicators of a broader increase in content knowledge. Thus, we recommend that students answer questions across a variety of chapters or topics and aim for at least a Mastery Level of 4 in each one.

Appendix A

Instructor Questions

Professor Houser also provided feedback on her use of prepU during Spring, 2012:

a) Which features of prepU do you like best?
The students can manage the program without instructor involvement. This can be a student-driven learning tool, yet it has the potential for instructor involvement as necessary.

b) Which features do your students like? And how do you know this?
Students like the questions being congruent with the text-book. They also like the rationale for why the right answer is right and the wrong answer is wrong. I know because they shared this with me.

c) Which features do you use the most regularly?
Checking on individual student progress and seeing how the mastery levels for the class as a whole is progressing

d) How often do you log in to the How's My Class Doing page?
Weekly

e) Which parts of the HMCD page to you like the most? Use the most?
Individual student stats and misconceptions

f) How do you use the data from prepU?
Remediation with students having trouble

g) What would you tell someone new to prepU? Hints/advice for a new user: what has worked for you?
Do not create tests—let the CAT system work.

h) Are you giving students mastery level assignments?
Sometimes—have not determined the "perfect" mastery level to have students achieve, so I encourage them to do many questions.