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Admission assessment: Linking a standardized admission exam to nursing program outcomes

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Abstract

This article reports the results of an academic program evaluation in which standardized admission test scores are compared to intermediate and final program outcomes. We used two intermediate program measures of progress—first semester nursing grades and performance on a standardized exit exam prior to graduation. Program final outcomes compared are student attrition and graduate nurses' performance on the NCLEX-RN®. The analysis resulted in identifying statistically significant relationships between entrance exam scores and first semester grades. Statistically significant relationships were seen between entrance exam scores and performance on a pre-graduation exit exam. There was a statistically significant relationship between entrance exam scores and NCLEX-RN® pass rates. These results indicate that admission testing is a viable option for use as part of an admission process for baccalaureate nursing programs.

Introduction

The continued challenge for schools of nursing is to balance workforce demands for graduate nurses against the limitations of available academic resources. The goal is to admit the best-qualified students most likely to successfully complete a rigorous professional education program of study. To accomplish this goal, nursing schools develop criteria for admission and selection standards that may include scores obtained on standardized admission tests.

There are several commercially developed, nationally-normed admission exams available to nursing schools. The purpose of all these exams is to determine if applicants possess the foundational knowledge necessary for learning complex nursing curriculum content. For our school, we use the Health Education Systems, Inc. (HESI) Admission Assessment Exam (A2) as part of our admission criteria and we also use the HESI Exit Exam (E2) to measure the end-of-program-knowledge outcomes of our graduates in preparation for the national licensing exam.

As part of the ongoing evaluation of the education programs offered by our school of nursing, we examined the relationship between student scores on the A2 and the predictors of student program

success: grades, attrition, performance on a standardized exit exam, and performance in the licensing exam. Specifically, we compared student admission scores to

- grades earned in first-semester nursing courses,
- attrition rates and program completion rates,
- performance on a standardized HESI exit exam (E2) taken prior to graduation,
- passage of the NCLEX-RN® exam on the first attempt.

Background

There is significant debate that the use of standardized tests may restrict progress for students who are otherwise prepared for successful licensure (Bussen, 2016; Dinatale Stoehr, 2014; Morin, 2006; Morrison, Adamson, Nibert, & Hsia, 2008; Nibert & Morrison, 2013; Nibert et al., 2006; Nibert & Young, 2008; Nibert, Young, & Adamson, 2008; Nibert, Young, Adamson, Spurlock, & Hanks, 2005; Spurlock, 2006; Spurlock & Hanks, 2004; Sullivan, 2011). However, other authors have supported the careful use of these assessment tools as a way to promote student success. These assessment tests could become a significant predictor, along with other measures, of education program quality (English & Gordon, 2008; Harding, 2010; Lavandera et al., 2011; Morrison, Adamson, Nibert, & Hsia, 2008; Morrison, Free, & Newman, 2008; Murray, Merriman, & Adamson, 2008; Randolph, 2017; Sosa & Sethares, 2015). These other common measures of program outcomes include completion rates, program attrition rates and, in some cases, performance on exit exams and performance on National Council Licensure Examination (NCLEX-RN®).

Assessment exams provide a snapshot of the knowledge required for nursing studies and provide some indication of the student's academic preparation. Grossbach & Kuncel (2011) published a meta-analysis that compared the general pre-college assessment exams (SAT and ACT) and student grade point average (GPA) to NCLEX-RN® passage. These assessments show some relationship to progression and success (Grossbach & Kuncel, 2011). However, Hinderer, DiBartolo, and Walsh (2014) found in their pilot study of 89 students that the HESI A2 score, preadmission GPA and science GPA had no significant relationship to each other. The A2 exam was correlated to the nursing GPA and NCLEX-RN® success but not with timely program progression (Hinderer, DiBartolo, & Walsh, 2014). Snyder and Hansen (2018) examined the admission criteria and performance on the NCLEX-RN® exam using the A2 exam as one of the admission criteria. Although the study did not predict success or failure on the licensing exam, higher student scores on the progression HESI exams and persistence to program completion were associated with NCLEX-RN® success (Snyder, 2018). While there is evidence to support the use of the A2 for the selection process into nursing school, there is less evidence of the relationship between A2 scores and student attrition to program completion at graduation. Since an entrance exam, in this case, is meant to determine which applicants are the most likely to be prepared for academic success in a nursing curriculum, it was necessary to establish a "cut-score," or the minimum score on the A2 that students would need to attain for program application.

We developed three objectives for this program evaluation based on "cut-scores." They include:

- compare students' grades at the end of the first semester of studies to their A2 exam scores to determine an optimal cut-score for the HESI A2,
- evaluate student program attrition related to cut-scores, and
- assess HESI E2 and NCLEX-RN® pass rates in relationship to cut-scores.

Method

This program evaluation was a retrospective review of aggregated, blinded student outcome data collected from 2004-2014. These analyses were conducted at a state-land grant university that is also designated as a Hispanic-Serving Institution (HSI). The undergraduate nursing student population is approximately 49% White, 50% Hispanic, and 1% other categories. For Stage One, the population group was 350 students. For stage two and stage three, the total population was 1,240 students admitted to the undergraduate nursing program. This review was approved by the university Institutional Review Board (IRB).

The evaluation was divided into three stages based on the objectives. When the use of the HESI A2 was instituted in this program, students were not required to obtain a minimal score before application. The first stage of this evaluation was to determine if a minimum admission score, or cut-score, would have a beneficial program effect. For Stage Two, we evaluated student attrition from the nursing program compared to the entrance cut-score and, for Stage Three, we examined the relationship between the cut-score and student success on the E2 and the NCLEX-RN[®]. Specifically, we wanted to determine if there was a relationship between the entrance exam scores and the number of student attempts to pass the E2 prior to graduation and the NCLEX-RN[®] after graduation.

Stage One: HESI Admission Assessment (A2) vs. First Semester Grades

In this stage, we examined A2 scores compared to nursing course grades in the first semester of studies. Students were allowed two attempts to take the A2 during an admission cycle and we would use their best score for admission purposes. The scores included HESI A2 assessments of student knowledge in anatomy and physiology, biology, chemistry, grammar, math, reading, and vocabulary. HESI recommends a composite score of 75% or higher for program admission.

The first semester courses for the entering nursing students included Principles of Nursing for 8 credits, Health Assessment for 3 credits, Pharmacology for Clinical Nursing Practice for 4 credits (included dosage calculations), and Pathophysiology for 3 credits. Final course grades were reviewed for students (n = 350) admitted between the fall semester 2004 and fall semester 2009. These grades were correlated to A2 composite scores and individual sub-scores using a Pearsons correlation test.

Stage Two: Attrition and Graduation Rates

The nursing program was initially a five-semester program that changed to a four-semester program in 2006. The expected time to program completion and graduation is four to five semesters with the understanding that some students might be held out a semester due to personal or academic reasons but still graduate within the four-five semester timeline. Attrition was defined as the number of students that either dropped out or failed out of the program. We defined our groups pre/and post- implementation of the cut-score. To assess attrition, we evaluated each cohort in each group by comparing the number of students admitted to a cohort to the number of students who graduated.

Stage Three: Comparing A2 Scores to Repeated Attempts on E2 and NCLEX-RN[®] Exams

Repeated testing affects later test scores as students gain experience with a standardized test (Spurlock, 2006). At this stage, we wanted to compare A2 scores to the number of student attempts to pass the E2 at the end of the program and the NCLEX-RN[®] after graduation. HESI, INC at that time recommended a minimum passing score for the E2 of 850. We compared the number of attempts to achieve an 850 on the E2 exam for both the pre-cut-score and post-cut-score groups. Students were allowed three attempts to pass the exam.

Kaddoura, Flint, Van Dyke, Yang, and Chang (2017) found significantly better first time NCLEX-RN® pass rates for second-degree seeking nursing students than for those students obtaining their first undergraduate degree. We excluded this group from the analysis to control for possible skew related to the higher performance of second-degree seeking students on the licensing exam. The number HESI E2 exam attempts to score 850 or greater was compared to A2 scores to determine any predictive feature of these exams. Student scores were compared for both exams for graduated cohorts admitted between 2004 and 2013 (n = 1070).

Results

Admission Assessment HESI (A2) vs. First Semester Nursing Course Grades (n = 350)

First, a review of student HESI A2 scores were compared to student final grades from their first nursing semester courses. Admission Assessment HESI (A2) scores showed a statistically significant correlation to the course grades (the higher the test score, the higher the course grade) (n = 350). Using multiple regression models revealed that some HESI scores were predictive of course success (Table 1). The HESI exams in biology (.187, p = 0.004), grammar (.289, p < 0.0001), and math (.219, p = 0.0003) were predictive of successful completion of the Principles course. The HESI exams in anatomy and physiology (.164, p = 0.02), grammar (.166, p = 0.02), and math (.162, p = 0.01) were predictive of successful completion of the Health Assessment course. The HESI exams in anatomy and physiology (.158, p = 0.02), grammar (.137, p = 0.04), and math (.256, p < 0.0001) were predictive of successful completion of the Pharmacology course. The HESI exams in anatomy and physiology (.161, p = 0.02), grammar (.162, p = 0.02), and math (.255, p < 0.0001) were predictive of successful completion of the Pathophysiology course. The greater the score on the HESI A2, the higher the grade was in the first semester course. While all the HESI A2 exams (anatomy and physiology, biology, chemistry, grammar, math, reading, and vocabulary) correlated to the first semester courses of the program, only anatomy and physiology, biology, grammar, and math exams reached statistical significance (See Table 1).

Table 1

First Semester Courses vs. HESI Admission Assessment Exams (A2) 2004-2006 (n = 350)

Course Passage with a 76% or better grade	HESI A&P	HESI Biology	HESI Grammar	HESI Math
Principles		.187, p = 0.004	.289, p < 0.0001	.219, p = 0.0003
Health Assessment	.164, p = 0.02		.166, p = 0.02	.162, p = 0.01
Pharmacology	.158, p = 0.02		.137, p = 0.04	.256, p < 0.0001
Pathophysiology	.161, p = 0.02		.162, p = 0.02	.255, p < 0.0001

Program Attrition and Completion

Second, students who were admitted to the program prior to a cut-score implementation in 2010 were compared to students after the cut-score related to persistence/attrition (See Table 2). To determine whether the cut-score for program entry showed a significant correlation with student completion rates, we performed an interrupted time series logistic regression using the data in Table 4. The dependent variable in our regression is a binary indicator of whether a student completed the program or failed/withdrew. The independent variables include: *Post-Cu* = binary indicator of whether the student was admitted before or after implementing the cut-score; *Admission Year* = the year in which the student was admitted; and *Year Post-Cut* = the number of years after implementation of the cut-score that the student was admitted (for example, a student admitted any year before 2010 would have a value of 0, a student admitted in 2010 would have a value of 1, a student admitted in 2011 would have a value of 2,

etc.). We also performed a Hosmer-Lemeshow test to check the goodness of fit of our model (See Table 3).

Table 2
Program Completion

Year Entered/Completed	Program Completion/Admitted	Completion Percentage	Attrition Percentage
2004/2006	90/100	81.82%	18.18%
2005/2007	99/117	84.62%	15.58%
2006/2008	113/125	90.4%	9.6%
2007/2009	77/110	76.24%	23.76%
2008/2010	158/192	82.29%	17.71%
2009/2011	79/101	78.22%	21.78%
Post-cut score 2010/2012	91/97	93.81%	6.19%
2011/2013	101/110	91.82%	8.18%
2012/2014	151/167	90.42%	9.58%
2013/2015	111/120	92.50%	7.50%
Program Total Over 10 Years	Average	86.29%	13.71%

Table 3
Interrupted Time Series Regression

Coefficients				
	B	S.E.	Z	Sig.
Intercept	147.578	117.660	1.254	0.210
Post-Cut*	1.233	0.484	2.546	0.011
Admission Year	-0.073	0.059	-1.241	0.215
Year Post-Cut	0.001	0.168	0.008	0.994

* significant at $\alpha=0.05$

Hosmer-Lemeshow Test		
Chi-square	df	Sig.
8.2635	8	0.4082

The results of the regression are shown in Table 3. We see that there is a significant difference in completion rates for students admitted before the cut-score was implemented and students admitted afterward ($p = 0.011$). In particular, students admitted after implementation of the cut-score are more likely to complete the program rather than fail or withdraw. The Hosmer-Lemeshow test results indicate that the model fits the data well ($p > 0.05$).

Comparing A2 to First Attempt at the NCLEX-RN® (n = 350)

We reviewed the data to find the relationship of the A2 scores for the initial student group (n = 350) analysis to the first and second attempts of the NCLEX-RN® licensure exam. Using a t-test, significant

statistical relationships were found in the initial study sample ($n = 350$) of A2 scores to the passage of the NCLEX-RN[®] licensing exam (See Table 4). Scores of 70 or greater on the HESI anatomy and physiology exam ($M = 70.4, \pm 12.6, p = 0.002$) were statistically significant to first attempt NCLEX-RN[®] passage. Scores of 77 or greater on the HESI biology exam ($M = 77.4, \pm 11.1, p = 0.0001$) were statistically significant to first attempt NCLEX-RN[®] passage. Scores of 76 or greater on the HESI chemistry exam ($M = 76.4, \pm 12.3, p = 0.02$) were statistically significant to first attempt NCLEX-RN[®] passage. Scores of 83 or greater on the HESI reading exam ($M = 83.8, \pm 8.8, p = 0.0004$) were statistically significant to first attempt NCLEX-RN[®] passage. Scores of 79 or greater on the HESI vocabulary exam ($M = 79.2, \pm 13.6, p = 0.001$) were statistically significant to first attempt NCLEX-RN[®] passage. Scores of 80 or greater on the HESI composite score ($M = 80.5, \pm 6.9, p < 0.00001$) were statistically significant to first attempt NCLEX-RN[®] passage. The results of this analysis allowed us to set a “cut-score” of 78% for admission.

Table 4

NCLEX-RN[®] 1st Attempt Pass Rate Compared to A2 Pre-Cut-Score ($n = 350$)

HESI Admission Assessment Exam (A2)	NCLEX-RN [®] 1 st Attempt Pass	NCLEX-RN [®] 2 nd or more Attempt Pass	p-value
Anatomy & Physiology	$M = 70.4, \pm 12.6$	$M = 63.9, \pm 12.1$	$p = 0.002$
Biology	$M = 77.4, \pm 11.1$	$M = 65.2, \pm 13.3$	$p = 0.0001$
Chemistry	$M = 76.4, \pm 12.3$	$M = 71.1, \pm 14.4$	$p = 0.02$
Reading	$M = 83.8, \pm 8.8$	$M = 77.7, \pm 13.4$	$p = 0.0004$
Vocabulary	$M = 79.2, \pm 13.6$	$M = 70.4, \pm 18.6$	$p = 0.001$
Composite	$M = 80.5, \pm 6.9$	$M = 74.5, \pm 8.5$	$p < 0.00001$

HESI Exit Exam Scores and NCLEX-RN[®] Pass Attempts

Finally, all student graduates HESI E2 scores were compared to the first attempt passage of the NCLEX-RN[®] licensing exam ($n = 1070$). Overall NCLEX-RN[®] pass rates during this period seem unchanged. As we compared our average HESI E2 scores to the NCLEX-RN[®] first attempt pass rates, we see some program improvement, but the results are not statistically significant.

After removing second-degree students (Kaddoura, Flint, Van Dyke, Yang, & Chiang, 2017), the average numbers of HESI E2 attempts appear right-skewed both before and after implementation of the cut-score. The Fligner-Killeen shows no difference in variance between the two distributions ($p = 0.9364$). Because the two distributions are asymmetric with homogeneity of variance, a Mann-Whitney U Test is used to test for a difference in the distributions. The Mann-Whitney U Test shows no significant difference between the average number of HESI attempts of pre-cut students and those of post-cut students ($p = 0.1060$)(See Figure 1).

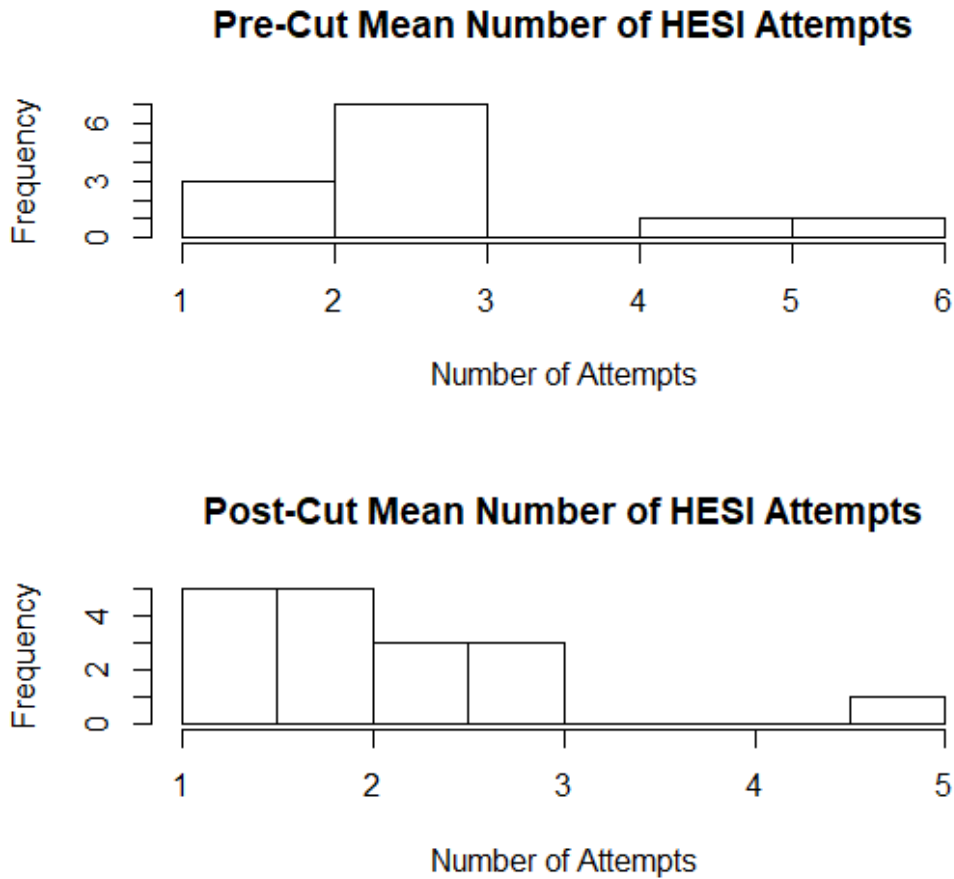


Figure 1. HESI E2 Attempts (n = 1070)

For additional analysis, we compared pre/post A2 cut-score groups with NCLEX® attempts after graduation. After removing second-degree students, the average numbers of NCLEX® attempts appear right-skewed both before and after the implementation of the cut-scores. The Fligner-Killeen shows no difference in variance between the two distributions ($p = 0.9364$). Because the two distributions are asymmetric with homogeneity of variance, a Mann-Whitney U Test is used to test for a difference in the distributions. The Mann-Whitney U Test shows no significant difference between the average number of NCLEX® attempts of pre-cut students and those of post-cut students ($p = 0.1060$)(See Figure 2).

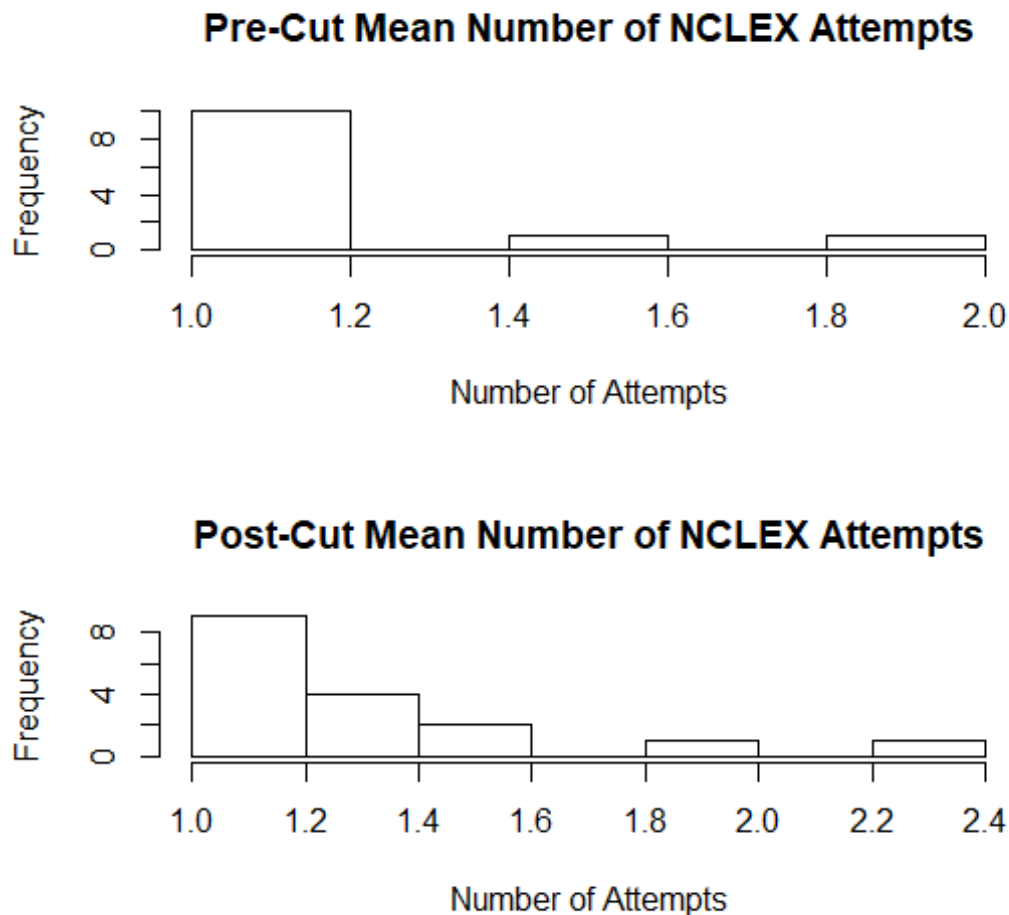


Figure 2. Number of NCLEX-RN® Attempts.

Discussion

Initially, we assessed the relationship between the A2 exam and first-semester nursing course grades. Success or failure in the first semester courses was highly correlated to A2 subcategory scores. We determined a composite score of 78 with at least 75% on each subscale was required for our applicant population to be successful in the first semester of nursing studies. Prior to this program evaluation, there was no required A2 exam score for admission. However, after the implementation of the “cut-score,” more students were able to pass the HESI E2 on the first attempt than pre-cut-score test-takers.

At the time of the exam composite score/course grade comparison, the first-semester course load was 18-semester credits. This was a very heavy course load and students struggled. After the adoption of the cut-score, we moved the Pathophysiology course to prerequisite status for program admission. This allowed for a logical progression from anatomy and physiology courses into pathophysiology prior to admission to the nursing program and lessened the workload for first-semester students.

For the second stage, levels of student attrition and program completion since instituting HESI A2 testing in 2004 were addressed. The national average for student completion of BSN programs is about 67% with an attrition rate of 33% (AACN, 2018). In reviewing the number of semesters taken to graduate, we have found that the percentage of graduated students (n = 1070) persisting in the program (finishing in 4-5

semesters) increased to 90.8% over the 10-year assessment period. Attrition for this same time period decreased to 13% on average with a drop to as low as 6% following the implementation of the cut-score.

The relevance of the NCLEX-RN[®] passage to the HESI E2 has been studied by others and many have found significant licensure exam success, (Johnson, Sanderson, Wang, & Parker, 2017) but we wanted to see if the predictive value of the HESI A2 exam could be applied to the NCLEX-RN[®] as well. As we saw little connection between A2 and NCLEX-RN[®] success in the overall sample, we believe there are additional variables over the course of two years that influence student success (Wilkinson, 2018). Many of these variables are personal experiences (marriage, illness, finances) that are difficult to quantify and measure in a program assessment.

Conclusion

The establishment of a minimum HESI A2 composite score has strengthened the program and allowed earlier identification of students at risk. The composite score is predictive of student success in their first semester of the nursing program. The progression and retention rates reflect that the students who were accepted after the cut-score was enacted showed a significant increase in program completion numbers and a significant drop in attrition.

For the purpose of program evaluation, we have found that the A2 can assist us with selecting students who are likely to successfully complete the baccalaureate nursing program. Certainly, this is seen in first-semester grades, although, grades obtained after the first semester were not analyzed. We did not analyze additional grades because our purpose was to evaluate success in the first-semester grades, attrition, and success in the E2 and NCLEX-RN[®] pass rates. This is a limitation that could be addressed in further program evaluation.

In terms of attrition, we found our attrition improved after the initiation of a cut-score. However, we suspect students admitted pre-cut-score may not have studied prior to taking the A2 exam while students admitted after may have studied more to ensure successful admission to the program. It is possible that students admitted after the cut-score implementation may be more motivated and, therefore, more likely to study after admission to the program (Labrague, McEnroe-Petitte, Fronda, & Obeidat, 2018). The attrition rate indicates that students were more likely to experience successful program progress to completion.

Future program assessment could be designed to help capture the effect of “soft” variables such as financial concerns or life events that distract or support program completion. For example, we evaluated students who did not complete the program due to personal illness or family concerns. Program assessment could be informed by qualitative investigations such as exit interviews and by comparing indicators of socioeconomic statuses, such as financial aid, and site secondary education to the program outcomes examined in this assessment. The impact of changing the placement of pathophysiology on A2 and E2 scores was not evaluated but would be included in the next cycle of assessment. However, based on these analyses, using the A2 with a cut-score derived from the performance of our own student population has helped us to optimize student progression and ultimate success without increasing our program costs.

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