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An Examination of Student Performance in Pre-Requisite Coursework and Upper Division Nursing Coursework

Abstract

Admission and retention of qualified nursing students are essential in meeting the demands of a rapidly changing health care environment and nursing shortage. The purpose of this exploratory correlational study was to determine the relationship between student performance in quantitative pre-requisite coursework and student performance in upper division nursing coursework in order to identify students at-risk for attrition. A series of descriptive and correlational analyses were conducted using pre-existing institutional data. A moderate relationship existed among the chemistry II and first-year upper division nursing courses ($r = .21$ to $r = .40$). These results suggest that prerequisite chemistry course performance could be a reliable predictor of academic success.

Keywords

pre-nursing, retention, coursework

Introduction

There is a serious shortage of nurses in the United States, and the problem will continue to grow. The number of students graduating from nursing programs has been insufficient to replace nurses leaving the workforce (Fischer, 2016; Peterson, 2009). Retention and graduation of students enrolled in schools of nursing are imperative in meeting the future health care needs in the United States.

Despite increasing enrollments in entry-level baccalaureate schools of nursing (BSN) (AACN, 2014), U.S. nursing programs turned away more than 50,000 qualified applicants to BSN programs in 2014-2015. Insufficient clinical teaching sites, a lack of qualified faculty, limited classroom space, insufficient preceptors, and budget cuts were the top reasons for not accepting all qualified students (AACN, 2015; Fischer, 2016). The Biennial Survey of Schools of Nursing (National League for Nursing, 2016) indicated 31% of BSN programs turn away qualified candidates because of the lack of faculty. Furthermore, 45% of BSN programs turn away qualified candidates because of the lack of clinical placements (National League for Nursing, 2016). To meet the challenges of the nursing shortage, the retention of students enrolled in all nursing programs must increase (Mooring, 2016).

Attrition rates are high for nursing students; some institutions report an average of 50% for BSN students and 47% for students enrolled in associate degree nursing programs (Newton & Moore, 2009; Peter, 2005; Peterson, 2009). Ehrenfeld, Rotenberg, Sharon, and Bergman (1997) suggest that the most attrition occurs within the first year of a nursing program. When students leave the program before completion, their “seats” remain empty for the duration of the program resulting in fewer graduates entering the workforce with lost tuition and fees for colleges and universities (ATI Nursing Education, 2007). With university budgets shrinking and tuition costs rising, the unsuccessful nursing student impacts the bottom line. An increase in the number of successful students will save resources and increase the number of registered nurses entering the workforce (Peterson, 2009).

Schools of nursing must examine student attrition within their programs and identify their student population needs (Harris et al., 2014). The challenge is to recruit increased numbers of qualified candidates and determine ways to decrease the rate of student attrition (Peterson-Graziose, Bryer, & Nikolaidou, 2013). While students may leave due to a number of reasons including academic failure, health issues, or financial difficulties (Abele, Penprase & Ternes, 2013), schools of nursing need to develop strategies to decrease student attrition by evaluating admission criteria, identifying students most at risk for failure as early as possible, and providing support for these students (Harris et al., 2014; Peterson, 2009). Acceptance into a nursing program is no guarantee of success. Once admitted, these students must receive support and be provided with resources to ensure their academic and clinical success (Shelton, 2012).

Background

The increased emphasis on program completion gives added importance to determining predictors of academic success in baccalaureate nursing programs. Many research studies documented the relationship between science courses, such as biology, chemistry, and pathophysiology, with student success in RN programs (Abele et al., 2013; Lewis & Lewis, 2000; Newton & Moore, 2009; Potolsky, Cohen, & Saylor, 2003; Wolkowitz & Kelley, 2010; Wong & Wong, 1999). Successful completion of science courses may also facilitate success with the NCLEX (Lockie, Van Lanen, & McGannon, 2013; Seldomridge & DiBartolo, 2004).

In a review of literature of pre-requisites for nursing in community colleges, Newton (2008) found that math and reading deficits were strong predictors of attrition. Potolsky et al. (2003) suggested that prerequisite science courses have a relationship to the academic performance of first-semester nursing students. Wolkowitz and Kelley (2010) used a standardized nursing entrance

exam to determine the relative strength of science, mathematics, reading, and English content in predicting early success in a nursing program. Results indicated that science was a statistically significant predictor of early nursing program success followed by reading, written/verbal, and mathematics (Wolkowitz & Kelley, 2010).

Lockie et al. (2013) examined the relationship between a number of demographic and academic variables of nursing graduates and their performance on the National Council Examination-Registered Nurses (NCLEX-RN). One of the predictors of performance was Chemistry 108 (principles of organic and biochemistry) grade. Graduates who performed poorly in Chemistry 108 were less likely to pass NCLEX-RN, which prevented them from entering the workforce.

Purpose

The purpose of this exploratory correlational study was to determine the relationship between student performance in pre-nursing quantitative coursework and student performance in nursing coursework for the first and second semester courses. Student performance is defined as course achievement, which is typically measured by grade point average (GPA) (Robbins et al., 2004). It was hypothesized that specific quantitative courses within the pre-nursing curriculum may forecast students' student performance within the nursing curriculum.

Methods

Research Design

This study implemented a correlational research design to determine the relationship between two variables using pre-existing quantitative data. The researchers designed this exploratory study to examine possible relationships between quantitative pre-requisite coursework and upper division nursing coursework.

Participants

The participants included 80 students who were admitted with a fall nursing school cohort and completed first and second-semester upper division nursing coursework. For these 80 participants, two participants could not be included because of unavailable transcript information. The sample included 65 (83.3%) females and 13 (16.7%) males. The racial classifications included 45 (57.7%) Whites, 20 (25.6%) Blacks, 7 (9.0%) Asians, 4 (5.1%) Hispanics, and 2 (2.6%) students who indicated other racial classifications.

Data Collection

Procedures. The researchers contacted the Director of the School of Nursing to obtain the names and student identification numbers of students who were admitted to the School of Nursing for the selected fall cohort. The data were received in an Excel spreadsheet. The researchers requested final grades from specific pre-requisite quantitative courses for the first attempt from the university's office of institutional research using the student identification numbers: MATH 1111 (College Algebra), CHEM 1151 (Survey of Chemistry I), CHEM 1152 (Survey of Chemistry II), PSYC 1101 (Introduction to General Psychology), and STAT 1127 (Introductory Statistics). These courses were selected based on their quantitative content and that more than 50% of the participants complete these courses during the pre-nursing prerequisite curriculum. If the participant transferred credit for any of these courses, the initial transfer credit was substituted. These data were received in an Excel spreadsheet. At the end of the fall semester, the researchers requested the final course grades for the following nursing courses from the nursing advisement office: NURS 3111 (first leadership course), NURS 3175 (pharmacology), NURS 3275 (first clinical course), and NURS 3276 (health assessment). At the end of the spring semester, the researchers requested the final course grades for the following nursing courses from the nursing advisement office: NURS 3112 (second leadership

course), NURS 3277 (second clinical course), and NURS 3279 (pathophysiology). Each of these data requests were received in an Excel spreadsheet. The pre-existing data sources were merged into one SPSS database for data analysis using the participants' college identification number.

Ethical Considerations

Before data collection began, an application was submitted to the university's institutional review board (IRB), which outlined all recruitment and data collection procedures. Once IRB approval was obtained, the researchers began the data collection process to acquire the pre-existing data sources. After obtaining Excel spreadsheets and merging the data, the SPSS dataset and the Excel spreadsheets were stored electronically on the principal investigator's password-protected computer to maintain confidentiality. All data was de-identified.

Data Analysis

A series of descriptive analyses (mean, standard deviation, minimum, and maximum) were conducted with the selected quantitative pre-requisite coursework and the upper division nursing coursework to summarize the data. Next, a series of bivariate correlational analyses were conducted using a Pearson r to determine the relationship between student performance in quantitative pre-requisite coursework and in first and second-semester nursing coursework. The criteria for a weak relationship was .10, moderate was .30, and strong was .50 (Cohen, 1988).

Results

Based on the descriptive analyses, the final grades for quantitative pre-requisite coursework ranged from D to A for CHEM 1151, PSYC 1101, and STAT 1127. For CHEM 1152 and MATH 1111, the

Table 1: Descriptives for Selected Pre-Requisite Quantitative Coursework

Course	<i>n</i>	<i>M</i>	<i>SD</i>
CHEM 1151	78	3.45	0.82
CHEM 1152	77	2.13	0.91
MATH 1111	52	3.17	0.92
PSYC 1101	37	3.49	0.65
STAT 1127	45	3.31	0.70

Note: Students are not required to take the same courses. Substitutes are allowed. The numerical values correspond to a four-point GPA scale.

Table 2: Descriptives for Nursing Coursework from the First and Second Semesters

Course	<i>n</i>	<i>M</i>	<i>SD</i>
NURS 3111	78	3.59	0.50
NURS 3112	65	4.00	0.00
NURS 3175	78	2.73	0.71
NURS 3275	78	2.77	0.64
NURS 3276	78	2.81	0.54
NURS 3277	65	2.74	0.73
NURS 3279	78	2.71	0.76

Note: If a student fails a fall semester course, he or she can only take NURS 3279 in the spring. The numerical values correspond to a four-point GPA scale.

final course grades ranged from F to A. The mean final course grade for CHEM 1151, MATH 1111, PSYC 1101, and STAT 1127 was a B. The mean final course grade for CHEM 1152 was a C. With the upper division coursework, the final course grades for NURS 3111 ranged from B to A with a mean grade of B. All participants earned an A in NURS 3112. For NURS 3175, NURS 3275, NURS 3276, and NURS 3279, the final course grades ranged from D to A, with a mean grade of C. The final course grades for NURS 3279 ranged from F to A, with a mean grade of C. Tables 1 and 2 display the means and standard deviations for the final grade in each course within the selected pre-requisite and first and second-semester nursing coursework. The numerical values in the tables correspond to a four-point GPA scale with 4.0 representing an A and 0.0 representing an F.

The results of the bivariate correlations indicated the most significant predictor of academic success in first and second-semester nursing coursework was CHEM 1152 (Survey of Chemistry II), which had approaching moderate to moderate relationships ($r = .21$ to $r = .40$) with all first and second-semester nursing courses. Another significant and moderate relationship ($r = .39$) existed between MATH 1111 (College Algebra) and CHEM 1151 (Chemistry 1), which was a pre-requisite for CHEM 1152. While MATH 1111 did not have a direct relationship with the nursing coursework, an indirect relationship existed, meaning academic success in the first and second-semester nursing coursework could be mediated by academic success in college algebra. A moderate relationship existed among the chemistry courses, and a moderate to strong relationship existed between the nursing courses, except NURS 3111. These relationships were not surprising given the similar content. NURS 3112 was not included in the data analysis because of the lack of variance. A

Table 3: Correlational Matrix for Selected Courses

Course	CHEM 1151	CHEM 1152	MATH 1111	PSYC 1101	STAT 1127
NURS 3111	.20	.27*	.13	.36*	.23
NURS 3175	.10	.40**	-.03	.16	.19
NURS 3275	.08	.21	-.14	.02	.30*
NURS 3276	.26*	.32**	.12	-.01	.03
NURS 3277	.14	.35**	.15	.32	.06
NURS 3279	.15	.23*	-.08	-.01	.09

Note: * = $p < .05$; ** = $p < .01$; NURS 3112 was not included because all students earned an A

moderate relationship existed between NURS 3111 and PSYC 1101 ($r = .36$) and between NURS 3277 and PSYC 1101 ($r = .32$). A significant, moderate relationship existed between STAT 1127 and NURS 3275 ($r = .30$). It is hypothesized that the content from these first and second-semester nursing courses allow the participants to apply the knowledge and skills

acquired in these pre-requisite courses. Table 3 displays the correlational matrix for the selected courses.

Discussion

A statistically significant, moderate relationship was found between the second chemistry course and academic success in the selected first and second-semester nursing courses. In addition, a significant, moderate relationship existed between college algebra and the first chemistry course. These results suggest that prerequisite chemistry course performance could be a valid predictor of academic success in this nursing program, which supports the findings of Lockie et al. (2013) and Potolsky et al. (2003). Similarly, Brennan, Best and Small (1996) found that students who fell behind in the first 2 years of nursing school had significantly lower mean pre-requisite course grades. The findings of this study add to the literature as the study results indicated pre-requisite non-nursing courses can be highly predictive of academic success within a nursing program.

The findings will have implications for nurse educators. Early identification of predictors of academic success and failure assists faculty and administration in providing efficient academic support (Ascend Learning, 2012; Lewis & Lewis, 2000). These results suggest that prerequisite chemistry course performance and college algebra could be valid predictors of academic success in the first and second-semester nursing courses. At-risk students must be identified, and remediation implemented early to give these students the best chance to be successful academically (Abele et al., 2013). Waiting until they have been admitted to the nursing program may not provide enough time for remediation strategies to be effective.

Universities may also offer opportunities to first-year students to interact with faculty and students in the nursing program. During these opportunities, faculty can facilitate discussion of the importance of performance in pre-requisite courses and the possible impact on admission to the nursing program. The nursing faculty and advisors could teach and participate in program-focused

freshman courses, which allow the new students to interact with nursing faculty. Shelton (2012) suggests that students with higher perceived faculty support were more successful in the nursing program and were more likely to persist until graduation. A study looking at first year attrition found that sensitivity to interpersonal interactions with administrative and teaching staff was significantly associated with intention to leave the university (Willcoxson, Cotter, and Joy, 2011). Wells (2003) suggests that positive relationships between nursing students and faculty are crucial to student retention and success in nursing programs.

Remediation requirements should be considered during the admissions process. Early identification and coaching/mentoring of at-risk students are necessary due to rigor and stress encountered during the first semester of the nursing major. Use of faculty mentors as well as student mentors will provide students with resources and activities to strengthen weak areas (Abele et al., 2013). Bowden (2008) found students identified personal tutors and peer tutors as having great impact on “staying” in the nursing program.

At-risk students should have access to high quality resources that support learning, including freshmen learning communities. Small cohorts of students in blocked program of study will provide opportunities for students to socialize and connect with other students. Bonet and Walters (2016) suggest a high positive impact for learning communities on academic success. Their study found these students to be more engaged with teachers, peers, and the intellectual content of their course resulting in higher grades. Other supports could include community outreach before the students enter the institution. Murray, Pole, Ciarlo, and Holmes (2016) found a pre-professional education program for high school students prepared the students for admission to the nursing program.

Lastly, a possible examination of the instruction strategies utilized within required pre-requisite coursework could assist with student retention. El Hussein, Salyers, and Osuji (2016) suggested the use of visual narrative illustrations to teach more complex topics. Likewise, Johnson and colleagues (2015) found the use of hands-on learning activities improved failure rates in an anatomy and physiology course. While both of these studies were conducted within upper division nursing coursework, the principle of incorporating more student-centered instruction instead of lecture and rote learning instruction could impact student achievement within the pre-requisite coursework.

In this nursing program, which was the project site for this study, several academic supports were developed or strengthened based on the findings of this exploratory study. First, all pre-nursing majors are strongly encouraged to participate in math and chemistry tutoring services offered through the university. In addition, pre-nursing students can participate in freshman learning communities involving nursing faculty and other peer support groups. Once admitted into the nursing program, any student who is at-risk for attrition is assigned to a peer mentor, which is facilitated by the nursing advisement office. Lastly, the nursing advisement office works to get these at-risk students into study groups and tutoring sessions for each upper division nursing course.

Limitations

There were limitations to this study. First, the sample was from one admission cohort at one state university. This study could be replicated with future cohorts at this state university and at other institutions to determine if the results are generalizable. Second, only the academic performance during the first and second semesters of nursing coursework was examined within this study. Future studies could examine a cohort across the 2 years of the upper division nursing coursework. Third, only required quantitative courses within the pre-requisite curriculum were included in this study. Future research could explore non-quantitative courses from the pre-requisite curriculum (e.g., humanities) to determine their relationship with the academic performance within the upper division nursing coursework.

Conclusion

The purpose of this exploratory correlational study was to determine the relationship between student performance in pre-nursing quantitative coursework and student performance in nursing coursework for the first and second semester courses. A moderate relationship existed among the chemistry II and first and second semester nursing courses ($r = .21$ to $r = .40$). The results indicate that the second chemistry course can be a valid predictor of academic success in the first and second semester nursing coursework. The findings have implications for retention strategies for BSN students, particularly those students who are at-risk. Administrators and faculty in this School of Nursing will continue to evaluate student performance in pre-requisite courses to identify at-risk students in order to better serve the needs of the student population. The goal is to reduce attrition from this nursing program and produce graduates who are prepared to pass NCLEX and succeed in their chosen profession.

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