First-year success in a nursing baccalaureate plan of study: A descriptive research study

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ABSTRACT

Background: Predicting students' aptitude for post-secondary success remains a widely studied topic. This descriptive study explored demographic variables contributing to success in quantitative courses required by the nursing degree plan. Identification of an "at risk" student profile may inform interventions with which to support attainment of an academic degree.

Objective: The purpose of this study was to examine the associations between demographic characteristics and successful completion of baccalaureate nursing courses thought to enhance quantitative reasoning skills: first-year math, first-year chemistry, and second-year pathopharmacology nursing.

Methods: This retrospective analysis accessed 4521 academic records of students who took these three courses at a United States university sometime between Fall 2008 and Fall 2015. De-identified student data included course grades, gender, full-time study, income, marital status, first generation, secondary school (also known as high school) location, dual credit, and high school and university grade point averages. Descriptive statistical analysis was conducted to describe the important features of the data.

Results: Of the 4521 records, 2556 undergraduates (57%) passed the courses in which they were enrolled. Among successful students, females outnumbered males (66%), ages ranged from 20 to 24 years, 86% were classified as low income, 54% fit the designation of first generation, and 12% earned dual credit (university credit during secondary school). Our data demonstrate a positive relationship between dual credit and success, with the strongest correlation (0.62) noted for students in pathopharmacology.

Conclusion: In the baccalaureate-nursing plan of study, courses thought to enhance students' quantitative reasoning skills remain difficult for some to successfully complete. We conclude that the more successful students tend to be older, have a higher income, and a higher high school grade point average, while those less successful are directly out of high school and have not earned dual credit.

1. Introduction

This descriptive study examines the variables that may contribute to student success in post-secondary education and is guided by the following research question: Can educators predict student success in post-secondary education? With no predictive model consistently identified across disciplines, curricular experts generally agree that mathematics, general chemistry, and pathophysiology are integral to undergraduate success in health-related fields because these courses strengthen a student's quantitative reasoning skills (Pitt et al., 2012; Stephens, 2005; Van Lanen et al., 2000). In particular, a nursing student's ability to provide safe client care rests, in part, on quantitative reasoning skills, e.g., using numeric evidence to interpret laboratory data, draw conclusions, solve the clinical problem, and communicate findings to the interdisciplinary team (Elrod, 2014).

All nursing graduates will encounter the need to apply learned quantitative skills (Arkell and Rutter, 2012; van de Mortel et al., 2014). We sought to better understand why 10% to 20% of our United States (US) students (unpublished data) failed courses addressing nursing pathophysiologic and pharmacologic concepts. Similar findings on Australian students have been published by Doggrell and Schaffer (2016) and Clifton and McKillup (2016). On our campus, pathophysiologic and pharmacologic concepts are addressed in one course called pathopharmacology, which reinforces the skills of quantitative reasoning taught and reinforced during earlier coursework. Before enrolling in pathopharmacology, nursing students successfully complete both first-year math and chemistry courses.

The purpose of this study was to examine the associations between demographic characteristics and successful completion of courses thought to enhance quantitative reasoning skills in undergraduate

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students. Specific aims were to (a) investigate student success rates in those courses developing their quantitative skills, i.e., first-year math, chemistry, and pathopharmacology nursing and (b) relate their success rates to specific demographic variables. We hoped to better understand those demographic characteristics possessed by students who succeeded in connecting just-learned skills with those needed in pathopharmacology.

2. Background Literature

Researchers investigating the relationship between demographic variables and academic success for nursing students include Pitt et al. (2012) who examined 44 US and non-US studies. For impact on academic success, these studies found mixed results for age, gender, hours of employment, and secondary-school performance. However, the variables of English as a second language, preadmission exams, and prerequisite course performance significantly impacted academic performance. Kowitlawakul et al. (2013) reported that for their sample of 60 second-degree baccalaureate nursing students, prior degree grade point average (GPA), prerequisite course GPA, and scores on an admissions test together explained 54% of variance "in the first semester GPAs" (p. 41).

Zhou et al. (2015) sampled 519 first-year students attending a medical university in mainland China; these students included nursing students. These researchers reported that the demographics of parental education, gender, entrance exam scores, and selected major accounted for 17% of the variance in first-year GPA. Not shared were results specific to nursing students. Shulruf et al. (2011) identified secondary-school achievements and university ranking as the best predictors of first-year GPA for 134 nursing students attending the University of Auckland.

Matriculation to university occurs in a different sequence for US students than for others. While in the United Kingdom (UK) and elsewhere, general education courses are taken during secondary school, US students encounter these during their first-year of a four-year baccalaureate plan of study (Gilbert, 2017). At our university, nursing students will take mathematics and a variety of bioscience courses during their first-year.

Nursing educators may lack a single predictive model because researchers have adopted differing definitions of "academic success," such as course success, graduation rates, retention or the adherence to plan of study, and licensure on first attempt. We chose to focus our definition of success at the course level and reviewed the evidence for three courses thought to enhance quantitative reasoning skills in undergraduate students.

2.1. First-year Math

Researchers have examined the relationship between a number of variables and success in developmental mathematics. For instance, Morrison and Schmit (2010) showed that variables predicting US course success were a readiness exam (ACT) and high school (HS; i.e., secondary school) GPA, while the number of HS math courses did not significantly predict success. Pugh and Lowther (2004) examined the relationship between time, in years, since last HS math and highest level of HS math successfully completed and students' performance in their first university math courses. This US research showed that high-risk students are those who did not take a math course during the senior year in HS or those students who failed to progress beyond HS algebra.

The ability of nursing students to apply mathematics and score well on subsequent drug-calculation tests was investigated by UK and Australian educators (Arkell and Rutter, 2012; van de Mortel et al., 2014). These authors concluded that calculation performance was predicted by adequate prior (i.e., secondary school) preparation along with student confidence in math ability.

In the US, Stephens (2005) reported no significant correlation

between the number of HS mathematics courses and the grade in a university algebra course. He concluded that for every study reporting a significant relationship between demographic variables and success in mathematics courses, there were additional studies that reported no relationships between the same variables. Seemingly contradictory findings occur when researchers use different models, study designs, definitions of "success," and student populations (Stephens, 2005).

2.2. First-year Chemistry

The relationship between success in general chemistry and a variety of demographic and academic variables has been examined (Hahn and Polik, 2004; Tai and Sadler, 2007; Easter, 2010) in students with a variety of academic interests. This research demonstrates that success in general chemistry was predicted by historical academic achievement, quality of prerequisite preparation, academic background, and student motivation and attitude.

Van Lanen et al. (2000) identified five predictor variables for success in chemistry courses. In their analysis, student age was an important covariate. The variables important for younger students (23 years or less) included scores on placement test, attending peer-led review (supplemental instruction) sessions, and success in previous chemistry courses. Variables important for older students (> 23 years) included previous chemistry course success and scores on a reading test assessing vocabulary and comprehension (the Nelson Denny Test).

2.3. Nursing Pathopharmacology

Dunn et al. (2013) investigated US students' causal attributions for success or failure in their pathophysiology course and concluded that students identified success as a result of internal attributions (e.g., confidence in ability) and identified failure as a result of external attributions (e.g., task difficulty). The researchers did not report a failure rate on demographic variables. Clifton and McKillup (2016) investigated Australian nursing-student satisfaction with bioscience courses (including human pathophysiology and pharmacology for nurses). They concluded that "there was no relationship between satisfaction and pass rate" (p.21). Student comments pertaining to their satisfaction suggested that it might be associated with perceived value of course content and support from the professor. Other predictors of course success were not shared by the authors. They reported a pass rate of 72–84% (p. 25). Pitt et al. (2012), while not asserting a relationship between prior science-course success and later nursing pathopharmacology success, did report inconsistent evidence for the impact of science courses on subsequent academic success.

Academics worldwide have investigated many variables and tested for impact on academic success. However, no single predictive model exists. We sought to better understand our student population and the pre-entry characteristics impacting success at the course level, specifically those courses enhancing the students' quantitative reasoning skills.

3. Methods

3.1. Participants

Twice per academic year, approximately 50 students are admitted into our baccalaureate nursing program after they complete 34 credits of prerequisites (each credit corresponds to about 15 h of classroom instruction), including 12 biology credits, four chemistry credits, and three math credits. Admission into this program is competitive, and most successful candidates have earned high grades in these courses. Students (n = 4512) in this sample took algebra (MA 111), chemistry for nursing majors (CHM 119, the second semester of a General-Organic-Biochemistry sequence), and/or Pathopharmacology I (NUR 271) at this university between Fall 2008 and Fall 2015. The algebra