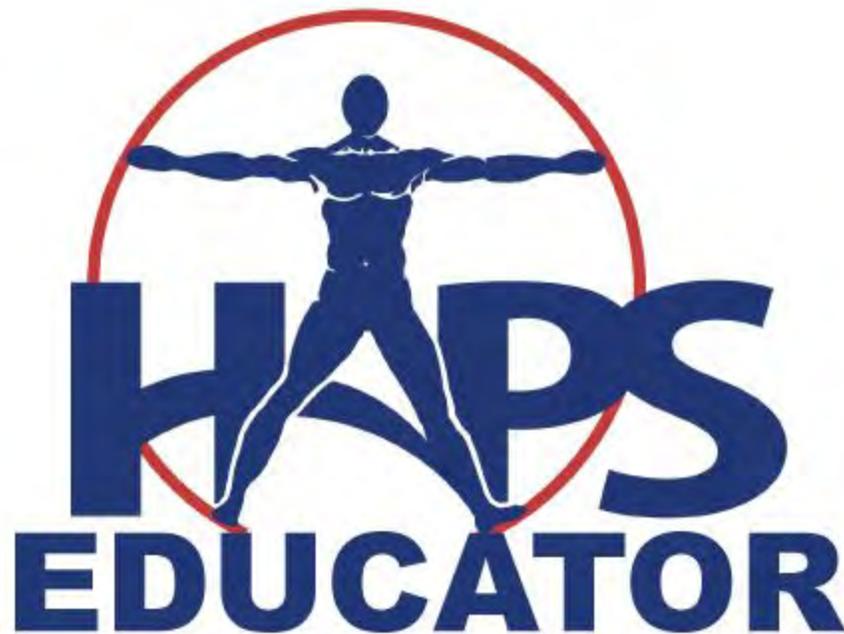**The Relationship Between Success in A&P and Completing an Early Online Academic Orientation**

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The Relationship Between Success in A&P and Completing an Early Online Academic Orientation

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Abstract

The current study examines if participants completing an early online academic orientation display significantly higher levels of achievement in anatomy and physiology (A&P) compared to those who do not complete this orientation. The study involves a sample of first year nursing students in a private Catholic college in a major midwestern city in the United States. A bivariate model indicates that success in A&P is significantly associated with composite test of essential academic skills scores (TEAS scores) and composite ACT scores. The bivariate model reflects those students who attend an early online academic orientation have significantly higher levels of achievement in an A&P course relative to those that do not. Future research may benefit from a mixed-methods design that might include a qualitative piece incorporating student perspectives regarding why attending an early academic orientation might be associated with higher achievement outcomes in A&P relative to those who do not attend such an orientation. http://doi.org/10.21692/haps.2022.004

Key words: achievement, academic orientation, anatomy and physiology

Introduction

Student success in anatomy and physiology (A&P) is an important research topic in nursing education. Success in A&P is a predictor for future success in nursing courses. The literature suggests that student success may be predicted by several factors, including standardized test scores (Harris et al. 2013; Schutte 2015), writing competency (Anderton et al. 2016), and participation in science coursework at the secondary education level (Vitali et al. 2020). However, level of success in A&P has not been substantially examined in relation to the presence or absence of early online academic orientation prior to beginning a college A&P course. The current study examined how achievement in a first semester A&P course differed among students who attended an early online academic orientation, compared to students who did not.

The literature links student success in A&P to several different factors. Student achievement may be predicted through participant high school GPA (Gultice et al. 2015). However, there are other notable factors. Anderton and colleagues (2016) observed that success may be correlated with student writing competence, although a similar relationship was not observed in terms of student reading ability. In terms of standardized testing, Schutte (2015) found that students who remediated A&P had lower SAT verbal and math scores than non-remediating students. In a study of nursing education attrition, Harris and colleagues (2013) noted that over half of unsuccessful nursing students had ACT scores lower than the national average and that 72% had repeated A&P coursework. While identifying other factors, Vitali and coworkers (2020)

suggested that exposure to science courses in high school was a determinant for student success in A&P at the college level. Additional considerations included a student's adaptability, emotional intelligence, and the mode of course delivery.

In nursing education, the impact of student success in A&P is monumental. The link between student grades in A&P and student performance on professional licensure exams has been documented since the 1980s (Quick et al.1985). In the 1990s, researchers linked A&P knowledge to success in a subsequent clinical nursing course (Griffiths et al. 1995). In a 2015 review of the literature, Sears and colleagues captured the ongoing, persistent nature of the relationship between student performance in A&P and success, especially regarding licensure exams. The research suggests that interventions to promote student success in A&P may be a promising tool to support long reaching student success.

With respect to improving student performance in A&P, research suggests that student preparation through orientation may factor into academic success. Traditionally, student orientation to college, including study skills and advising information, has been identified as playing a pivotal role in student retention (Davig and Spain 2003). The ongoing work of McKenna et al. (2018) further suggests that student orientation is associated with significantly higher end-of-term grades. Additional investigations suggest that the development of an academic mindset, characterized by a sense of self-efficacy, is specifically associated with student success (Han et al. 2017).

Because A&P is frequently a gateway course for future studies in health sciences, success in its coursework largely determines a student's educational trajectory. The current study assessed the impact of academic orientation as a tool for promoting academic success in A&P. In this case, academic orientation was distinguished as a process that was distinct from generalized student orientation. Here, the term "academic orientation" refers to content that addresses topics which include college-level learning content, college learning management systems, and any innovative cloud-based technologies and courseware that are integrated into the college learning management systems. The study examined whether students who attend an early online academic orientation have a significantly higher level of success in A&P relative to students who do not attend an early online academic orientation.

The analysis included several variables that were predictors of success in A&P, such as composite ACT scores and composite test of essential academic skills (composite TEAS scores). The analysis represented an early attempt to identify best practices in orientation for student success in A&P. Preliminary data suggested that the positive impact of college orientation may be determined by orientation content. The early academic orientation modules students utilized in this study were in cloud-based courseware that was deeply integrated into their college learning management system.

Three competency-based learning modules were developed for the early online academic orientation. The modules were approximately two hours each and covered the fundamentals of biology, fundamentals of chemistry, and fundamentals of scientific skills. Teaching strategies used in these early online academic orientation modules included active learning as the core pedagogy and relied on activating information from existing knowledge. Students were encouraged to organize their thoughts through sketches and or in note taking apps. Learning objectives were provided as short answer questions at the end of each module, to enhance student understanding of the material they would be expected to use as a foundation for scaffolding later in the course. Instant feedback was given to each of the short answer learning objectives, so the students could self-identify and build in their metacognition.

Module 1 included an introductory biology overview. Cell structure: cell metabolism, cellular transport, cell division, DNA, nucleic acid structure, DNA replication, and gene expression were covered in this module. Module 2 included an introductory chemistry of life overview. Content for this module included atoms, molecules, chemical bonding, acids and bases, and major macromolecules. Module 3 included an overview of scientific skills. Content for this module included graphing and interpretation, fundamentals of math, understanding exponents, units of measurement, and dimensional analysis. Collectively it took students between six to nine hours to complete all three modules.

The early online academic modules were originally placed in the LMS prior to the arrival of students on the first day of class. The early online academic orientation modules were open from the time of their general college orientation (June and/or July) through the second week of the fall semester course (August). The three early online academic orientation modules collectively were assigned the same number of points as one quiz assignment. Students in this course were allowed to drop their lowest quiz grade; if they did not complete the early online orientation, it did not academically penalize them.

Methods

At a private single-purpose nursing college composed of primarily female (86%) nursing students, all entering first-year undergraduate students were provided with a general college orientation that equipped them with resources to understand policy and to find support. Of the 94 students enrolled in the first semester of a two-semester A&P course, 82 chose to enroll in the additional online academic orientation (the "treatment"). The remaining 12 students served as the control group.

As this is a quasi-experimental design for evaluation of the effectiveness of the online academic orientation, non-random assignment of study participants to either "treatment" or "control" was important for ethical reasons so that all students had equal opportunity to complete the orientation. Data gleaned from the orientation process has been shared under the supervision of the Institutional Review Board, which approved analysis and dissemination.

In terms of standardized test results, the scores of the 94 students were evenly dispersed among attendees and non-attendees. The institution uses TEAS (Test of Essential Academic Skills) to assess student placement. The TEAS is an exam that helps assess if a student has the necessary knowledge and comprehension to enter a nursing college or other related allied health field. The company that forms the test is Assessment Technologies Inc. (ATI). Of the entering students, 43.6% (n=41) scored at a basic level for their incoming academic skills, while 51.1% (n=48) scored at a proficient level and 5.3% (n=5) scored at an advanced level for their incoming academic skills. The average study participant enrolled with an ACT composite score of approximately 21.4 (M = 21.4; SD2.95; Min/Max 16.00/29.00).

Previous analyses on data from 713 first time-in-college (FTIC) students who took this first semester A&P I course during an eleven-year period, provide foundational comparison of the study participants' incoming academic preparation. While this large group of students could serve as a potential control group in future studies if the 82 students who opted into the academic orientation are removed, this study utilizes the non-attendees within the single cohort as a control group. Testing for equal variance was conducted, as will be discussed in the

section entitled Multivariable Analysis, and the two samples met the criteria for equal variance despite obvious unequal sample size.

The purpose of this comparison group is to illustrate that the study participants have similar academic levels to those of surrounding years, thus increasing the generalizability of the data. Using this larger group of students, exploratory multivariable analyses were also conducted to verify the correlations identified within the study participants, as will be discussed in the data analysis. In the larger group of students, the average TEAS score was 60%. A TEAS score of 60% is close to the national average and would classify a student as "Proficient" by ATI. This same comparison group had an average ACT composite score of 22, and an average high school GPA of 3.57. High school GPA, TEAS composite scores, and ACT composite scores were similar in both the larger group of 713 students and the study population of 94 students.

The same Associate Professor of Biological Sciences has taught this A&P course for the past two decades. The professor used the same textbook, courseware, tests, and student learning objectives for all students in the experimental study (94) and for the larger comparison group. The lab ratio historically over the past decade has been sixteen students: one faculty member for laboratory sessions and fifty students: one faculty member for lectures.

Measurement Instruments

A short scale examining study demographics (e.g., TEAS composite scores and ACT composite scores) was created for the current study. Completion of early online academic orientation modules was measured with a single item *Have you completed the early online academic orientation modules?* (Yes/No). The construct success in A&P was measured using a 5-item scale created for the current study. Grades were measured along a scale of 1 (Grade of F) to 5 (Grade of A).

Data Analysis

Data analysis was conducted in three phases. First, all data were analyzed descriptively utilizing univariate analysis. Second, the relationship between the dependent variable success in A&P with the independent (did you complete the early online academic orientation modules?) and covariate (composite TEAS, composite ACT) variables were analyzed using bivariate analysis. Third, multivariable regression analysis was performed to control for other demographic and academic preparedness variables while examining the relationship between A&P grades and completion of the academic orientation.

Prior to data analysis was an examination of test assumptions indicating satisfactory levels for multicollinearity, linearity, and homoscedasticity. Based on a G* Power estimate of multiple regression, with power set at 0.80 and a probability set at 0.05, a medium size effect (0.15) would be detectable using a sample size of 54. The power analysis indicated 54

students was the minimal sample size required to detect a relationship between the three variables (TEAS composite, ACT composite, and the independent variable: whether or not the student completed the early online academic modules) prior to beginning their first semester of A&P at the college. Checks of data integrity were initially collected from 94 students. Five students had missing ACT composite scores, as they were adult learners and had attended high school more than 10 years prior to enrolling at the college. These five students were kept in the study. Codes were utilized during the analysis to represent the missing data while using SPSS statistical software. The final sample for the study included 94 students.

Results

Table 1 presents a descriptive analysis of the variable tracking student completion of the academic orientation. More than half of the students completed the early academic online orientation modules before beginning their first semester of A&P (n = 82, 87%). Table 2 represents a descriptive analysis of the variable success in A&P. Data indicate that the score reflecting success in A&P was 3.28 (SD 1.13; Min/Max 1.0 - 5.0).

Variable	n	%
TEAS Composite	94	
Basic	41	43.6%
Proficient	48	51.1%
Advanced	5	5.3%
Academic Orientation Modules	94	
Completed	82	87.2%
Did not complete	12	12.8%

Table 1. *Descriptive Analysis of Categorical Study Variable (n = 94)*

Variable Range	Mean (SD)	Min/Max	Scale
A&P I Grade	3.28 (1.13)	1.0 – 5.0	1.0 – 5.0
ACT Composite	21.4 (2.95)	16 – 29	1.0 – 36

Table 2. *Descriptive Analysis of Continuous Study Variables (n = 94)*

Bivariate Analysis

Table 3 presents a bivariate analysis comparing the dependent variable success in A&P to the first covariate variable: student TEAS composite scores. One-way ANOVA indicated a significant difference (F = 12.79, $p < 0.001$) between mean scores. A Bonferroni post hoc test indicated the mean score for success in A&P differed where: 1) The score for the TEAS composite Basic; M = -0.9385, (SD = 0.2146) was significantly lower than Advanced and Proficient composite TEAS scores; 2) The score for Proficient M = 0.9385 (SD = 0.2146) was significantly higher than Basic but lower than Advanced scores; and 3) The scores for the Advanced, M = 1.692 (SD = 0.4780) were significantly higher than Basic and Proficient Scores.

Table 4 presents a bivariate analysis of success scores and ACT scores. Student composite ACT scores and success in A&P were positively correlated at a statistically significant level (r (94) = 0.44, $p < 0.01$).

Multivariable Analysis

As further context for the relationship between academic preparedness and first year cumulative college GPA for BSN students at the college, separate multivariable analyses have also been conducted on freshmen from 2010 through 2020, which is inclusive of the cohort of 94 students that constituted the direct study population. For first-time college students (i.e., those having no college transfer credit) entering college during the fall, multiple regression models were constructed to evaluate the predictive values of three preparedness measures: high school grade point average, composite ACT score, and composite TEAS score. There were 913 students in the initial analysis, though only 713 had non-missing values for all variables used in the final multivariable regression model.

Prior to building the models for first-year outcomes, correlation tests were conducted to investigate the multicollinearity among the three preparedness variables. A Pearson correlation test indicated that high school GPA and composite TEAS scores were moderately correlated (r (793) = 0.44, $p < 0.0001$). Spearman correlation tests indicated that high school GPA and composite ACT scores were also moderately correlated (rs (887) = 0.36, $p < 0.0001$), and TEAS scores and ACT scores were strongly correlated (rs (769) = 0.68, $p < 0.0001$).

Considering the strong correlations between TEAS and ACT scores, it was determined that only one of them should be included in a multivariable regression in order to avoid excessive multicollinearity. Two different simple linear regressions were run using each of the preparedness variables to find which measure of preparedness had the strongest predictive value of first-year college GPA. The regressions revealed that TEAS scores and ACT scores each had a weak but significant positive correlation with first-year college GPA. Compared to the ACT score, the TEAS score explained a slightly higher percentage of the variance in first-year college GPA and was significant F (1,711) = 142.0, $p < 0.0001$, $R^2 = 0.17$, $R^2_{adjusted} = 0.17$). When the TEAS score and high school GPA were both included in a regression model, 22 percent of the variance in first-year college GPA was accounted for by the variables in the model (F (2,710) = 101.4, $p < 0.0001$, $R^2 = 0.22$, $R^2_{adjusted} = 0.22$). Using forward selection step-wise regression with the demographic variables gender, ethnicity, and campus coded as dichotomous variables (female = 1, male/unknown = 0; Black, Indigenous, or Person of Color (BIPOC) = 1, White/unknown = 0; enrolled at regional campus = 1, main campus = 0), a significant multivariable regression model emerged with gender and campus included along with TEAS score and high school GPA as predictors of first-year college GPA (F (4,708) = 53.83, $p < 0.0001$, $R^2 = 0.23$, $R^2_{adjusted} = 0.23$).

A significant multivariable regression model was built with the following independent variables explaining about 33 percent of the variance in final A&P grades: high school GPA,

	n	Mean (SD)	t (df)	p
Did you take A&P I				
Without completion of early academic online orientation modules?	12	2.25 (1.06)	12.79 (98)	<0.001
With completion of early academic online orientation modules?	82	3.43 (1.18)		
TEAS				
Basic	41*	2.71 (1.03)	12.84 (2,92)	<0.001
Proficient	48*	3.65 (1.0)		
Advanced	5*	4.00 (.89)		

Table 3. *Bivariate Analysis of Categorical Variables (n = 94)*

Variable	1	2
ACT composite	--	0.44**
Success in A&P (Grade)		--

** p <0.01

Table 4. *Pearson's r Correlation Analysis (n = 94)*

TEAS score, gender, campus, and ethnicity (F (5,180) = 18.96, $p < 0.0001$, $R^2 = 0.35$, $R^2_{adjusted} = 0.33$). In this model, the TEAS score, high school GPA, and ethnicity (identifying as BIPOC) were all significant predictors of a student's A&P grade at α = 0.05. Table 5 presents the full results from this multivariable regression.

This multivariable regression using 11 years of student data in a highly consistent A&P course serves as an important backdrop to further investigation of the original study population (the 94 students who were given the option to attend an early online academic orientation). Using multivariable regression on this subset of students, statistical controls were employed to ascertain whether any of the demographic or academic preparedness factors explored in the previous regression models were primarily responsible for the improved A&P grades among students who attended the academic orientation, or if A&P grades were predicted by attending the early online academic orientation.

To specifically assess the explanatory power of attending the online academic orientation on A&P grade when controlling for TEAS score, high school GPA, ethnicity, and gender, a multivariable regression model was constructed for the students with non-missing values for their final A&P grade (i.e. students with a letter grade A-F, excluding incompletes and withdrawals) and non-missing values for all other variables in the model. The final subset with non-missing values included 63 students, with 52 who attended the academic orientation

and eleven who did not. Regional campus attendance was not included in this model because the cohort offered the early academic orientation were all enrolled at the institution's main campus.

Prior to building this model using the reduced subset of sixty-three students, a two-sample *t*-test was performed to recheck the difference in mean A&P grades between the orientation attendees and the non-attendees. An F-test to check equality of variance between the two groups was not significant, confirming that variances were equal, and testing could proceed. There was a significant difference in mean A&P grades (*t* (64) = -5.02, $p < 0.0001$) with orientation attendees having a higher average. Having confirmed the significant difference in average grades and the equal variance between the control and treatment groups within this subset, the regression model was an appropriate next step.

The model was statistically significant with the predictors explaining 39% of the variance (F (5,57) = 8.88, $p < 0.0001$, $R^2 = 0.44$, $R^2_{adjusted} = 0.39$). In this model, attending the academic orientation was a highly significant predictor of a student's A&P grade ($p = 0.0001$) with a positive slope. TEAS score and high school GPA were also significant predictors in a positive direction.

When comparing standardized beta coefficients of the three significant independent variables (attendance at academic orientation, TEAS score, and high school GPA), attending the academic orientation had the strongest effect on a student's A&P grade, as seen in Table 6. This result supports the findings of the descriptive and bivariate analyses and indicates that attendance at the academic orientation predicted a significantly higher grade in A&P compared to those who did not attend, even when controlling for demographic and academic preparedness variables.

Effect	B	SE B	β	t	p
TEAS Score	6.09	0.80	0.52	7.58	<0.0001
High School GPA	0.46	0.21	0.15	2.24	0.026
BIPOC	0.40	0.17	0.15	2.38	0.018
Female	0.08	0.29	0.02	0.29	0.775
Regional Campus	-0.37	0.26	-0.09	-1.43	0.154

Table 5. *A&P Grade: Multiple Regression (n=186). B = unstandardized beta, SE B = standard error for the unstandardized beta, β = standardized beta.*

Effect	B	SE B	β	t	p
TEAS Score	1.99	0.82	0.25	2.44	0.018
High School GPA	0.73	0.25	0.30	2.96	0.005
BIPOC	0.17	0.22	0.08	0.74	0.460
Female	0.14	0.42	0.04	0.34	0.738
Attended Academic Orientation	1.28	0.31	0.45	4.13	0.0001

Table 6. *A&P Grade: Multiple Regression (n=62). B = unstandardized beta, SE B = standard error for the unstandardized beta, β = standardized beta.*

Discussion

The findings of this study support the hypotheses that first semester A&P students who complete an early online academic orientation have significantly higher levels of success in A&P relative to those who do not. The analysis also suggests additional factors correlated with A&P grades include ACT score, TEAS score, high school GPA and, possibly, ethnicity.

While these findings support the development and implementation of a robust early online academic orientation for entering students, the findings also identify factors related to student success which extend beyond the reach of college educators. Student preparation for success in higher education begins well before college admission.

Limitations

The findings of the study are limited by the scope of investigation. A larger project may take into consideration data collected throughout a student's college career. Because enrollment in academic orientation was voluntary, it must be acknowledged that students who opted into such a program may be predisposed towards academic success. However, it is also possible that some students enrolling in the orientation program are less confident in their academic skills and have reason to believe, perhaps due to prior experience in science courses, that they need the additional review of material. Likewise, some students with strong academic preparation may skip the orientation program because they predict they will succeed in A&P without it.

Controlling for academic preparation indicators such as TEAS and high school GPA attempts to account for these differences, but future studies could also incorporate a measure of student perception of their own abilities. Incoming students at this institution participate in a new student survey, which asks about their levels of confidence and how they perceive their academic abilities compared to "average" levels; such data could be leveraged to further control for differences in academic predispositions and attitudes.

Furthermore, deeper multivariable regression analysis should consider additional demographic characteristics that were not readily available in the institutional student database, such as income status and whether or not they are first-generation college students. Other dimensions of analysis in the future will also look specifically at the science portion of the ACT and the TEAS tests, rather than the composite score.

Another limitation of this study is the sample size for conducting comparison, since most students opted into the program, resulting in a small group of non-attendees. The relatively small number of students who remained in the final multivariable regression is a result of a combination of missing values of demographic or academic preparation variables, along with the withdrawal of some students from the course or the institution for reasons that may have nothing to do with academic difficulty. While the general rules of thumb are met for reasonable sample size for regression analysis (Voorhis and Morgan 2007), further analysis could incorporate multiple years of data to increase the sample size of non-attendees. A simple expansion could potentially use the preceding year of enrollees, where the entire earlier cohort would function as non-attendees for comparison.

Conclusion

The finding that students who completed early academic online academic orientations achieved significantly higher levels of success in A&P relative to those who did not suggests that the early online academic orientation should continue as part of the college general orientation. Student surveys were not conducted qualitatively to determine if they thought the online orientation helped them prepare for their first semester of courses. In the future, it is suggested that a qualitative study be conducted to examine if the early online orientation helped orient students to the college learning management system and the cloud-based technology they would be using in their first semester courses.

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Literature Cited

Anderton RS, Evans T, Chivers PT. 2016. Predicting academic success of health science students for first year anatomy and physiology. *Int J High Educ 5*(1):250-260. https://doi.org/10.5430/ijhe.v5n1p250

Davig W, Spain JW. 2003. Impact on freshman retention of orientation course content: Proposed persistence model. *J Coll Stu Ret Res Theor Prac 5*(3):305-323. https://doi.org/10.2190/V6B4-PQAW-TTV0-CJCU

Griffiths MJ, Bevil CA, O'Connor PC, Wieland DM. 1995. Anatomy and physiology as a predictor of success in baccalaureate nursing students. *J Nurs Educ 34*(2):61-66. https://doi.org/10.3928/0148-4834-19950201-05

Gultice A, Witham A, Kallmeyer R. 2015. Are your students ready for anatomy and physiology? Developing tools to identify students at risk for failure. *Adv Physiol Educ* 39:2:108-115. https://doi.org/10.1152/advan.00112.2014

Harris RC. Rosenberg L. O'Rourke MEG. 2013. Addressing the challenges of nursing student attrition. *J Nurs Educ* 53(1):31-37. https://doi.org/10.3928/01484834-20131218-03

Han CW, Farruggia SP, Moss TP. 2017. Effects of academic mindsets on college students' achievement and retention. *J Coll Stu Dev* 58(8):1119-1134. https://doi.org/10.1353/csd.2017.0089

McKenna BM, Finamore D, Hewitt V, Watson L, Millam LA, Reinhardt M. 2018. The effect of a multifactor orientation on student performance: Organizational skills, goal setting, orientation to classroom, and academic support. *Online Learn J 22*(4):265-276. https://doi.org/10.24059/olj.v22i4.1207

Quick MM, Krupa KC, Whitley TW. 1985. Using admission data to predict success on the NCLEX-RN in a baccalaureate program. *J Prof Nurs 1(*6): 364-368 https://doi.org/10.1016/S8755-7223(85)80060-0

Schutte AF. 2015. Who is repeating anatomy? Trends in an undergraduate anatomy course. *Anat Sci Educ* 9(2):171-178. https://doi.org/10.1002/ase.1553

Sears NA, Othman M, Mahoney K. 2015. Examining the relationships between NCLEX-RN performance and nursing student factors, including undergraduate nursing program performance: A systematic review. *J Nurs Educ Prac* 5(11):10-15 https://doi.org/10.5430/jnep.v5n11p10

Vitali J, Blackmore C, Mortazavi S, Anderton R. 2020. Tertiary anatomy and physiology, A barrier for student success. *Int J High Educ 9*(2):289-296. https://doi.org/10.5430/ijhe.V9n2p289

Voorhis, CWV, Morgan B. 2007. Understanding power and rules of thumb for determining sample sizes. *Tut Quant Meth Psychol 3*(2):43-50. https://doi.org/10.20982/tqmp.03.2.p043