STTI/ATI Grant Project Report

Project Title: Predicting NCLEX Failures Using Standardized Assessments

The purpose of this quantitative, non-experimental cross sectional study was to explore

the use of Principal Components Analysis (PCA) to recognize redundancy and correlations in the

variables – standardized Content Specific Assessments (CSA) – in a sample of first-attempt

NCLEX failures from multiple programs across the US. If redundancy of content assessed is

present, then the number of CSA could potentially decrease to those found to account for the

most variability in each component of the two-component model. This study was the first step in

identifying CSA for future use in predicting NCLEX outcomes. The long term goal using the

findings of this study is to predict NCLEX failures with increased levels of accuracy over

existing levels found in the literature.

Theoretical Framework

Constructivism provides a solid framework to explain knowledge development to prepare

pre-licensure students for NCLEX success. NCLEX failures can be viewed as faulty construction

of the content and concepts needed for the role of the nurse. More specifically, psychological or

individual constructivism supports the idea of students constructing their own cognitive

structures as it relates to specific situations (Woolfolk, 2011). Students' link previously learned

content and concepts with experiences to form new information toward obtaining the knowledge

and skills needed to function as a safe, effective nurse to care for society. New information is

continuously connected to develop the body of knowledge needed to function in the role of the

nurse. This process continues and supports lifelong learning.

Each content area learned in a program of study is connected to previous knowledge in

subsequent courses. When CSA scores reflect inadequate levels of achievement, the foundation

of knowledge is inadequate. The purpose of this study was to recognize those inadequate CSA variables that could be associated with NCLEX failures. The literature provides inconsistent and weak evidence for CSA to predict NCLEX failures.

Methods

Design

A retrospective, multivariate quantitative design, utilizing Principal Component Analysis (PCA), was conducted for further statistical inference. The model sought to reveal any emerging distinct response patterns through detection of redundancy in CSA scores from samples of pre-licensure program graduates with reported first-attempt failure on NCLEX.

The Institutional Research Review Board at the University of Arkansas gave exempt status to the study.

Sample

A purposive sampling design was employed to achieve representativeness typical of the larger population and, consequently, comparable across studies. Participating nursing programs were sought through networking opportunities at conferences and through telephone and email solicitation to achieve the largest sample size possible of student standardized assessment scores and remain within the time limitations of the funding agency.

Practical, associate degree, and baccalaureate programs of nursing were asked to participate in the study by providing de-identified CSA results for all students failing NCLEX on the first attempt between spring 2009 and spring 2016. Inclusion criteria for the student standardized assessment data in the sample were (a) completion of the respective program of nursing; (b) completion of a minimum of three content specific assessments and/or the exit examination; and (c) recorded failure of NCLEX on the first attempt.

The specified sampling design and study inclusion criteria resulted in retrospectively collected, CSA score data from 11 programs of nursing for $n = 296$ students, which far exceeds the minimum sample size of 100 that is recommended when high communalities and a small number of retained components are observed during the data analysis.

Instruments

Commercially available SAP offer practical, associate, and baccalaureate programs of nursing tools to assist students for success on NCLEX. SAP from the various commercial vendors such as ATI, Kaplan, and HESI include similar standard content areas such as foundations of nursing care, pediatrics, maternal/newborn, pharmacology, adult medical-surgical, mental health, leadership, and an end-of-program comprehensive predictor examination. Given that sampled nursing programs self-select the vendor of the SAP utilized at the institution, CSA scores provided by the institutions might vary somewhat in content. The sample CSA scores will be matched across vendors after Z-score transformation, with scores most closely aligned and corresponding to these eight standard content mastery assessment areas included in the study.

Statistical Analysis

Principal component analysis

PCA is a multivariate technique where observations are described by several inter correlated quantitative dependent variables. The goals were to extract the important information to represent as a new set or orthogonal variables, compress the size of the data set by keeping only the most important information, simplify the description of the data set and, analyze the structure of the observations (Abdi & Williams, 2010, p. 434). The orthogonal rotations identify

and eliminate the redundancy in the CSA scores to focus on the information most important in those students failing NCLEX-RN.

The primary purpose of this retrospective, cross sectional pilot study was to explore the utility of Principal Components Analysis (PCA) as a reduction procedure to discover the most important information in the form of CSA in a sample of NCLEX-RN failures. The secondary purpose was to determine if the information can reduce the number of CSA administered to students across a program of study while maintaining the ability to identify students at risk for NCLEX failure. The reduced CSA will then be analyzed for use in predicting NCLEX failure with an increased level of probability. The predictive ability of the emerging CSA will be completed in a follow-up study.

Each participating program of nursing self-reported, de-identified, student-level data including corresponding first attempt CSA and exit examination scores that were merged into vendor-specific spreadsheets. Student-level data that did not meet the inclusion criteria for the study were removed at this point in the analysis. The vendor-specific, student-level CSA score data were transformed to Z-scores prior to being merged into a larger file for Principal Component Analysis. The standardization of CSA scores within vendors will eliminate the variations present in the scoring of different versions of the assessments.

Statistical Analysis

De-identified, standardized CSA scores were imported from the data spreadsheet into IBM SPSS version 23.0 for PCA. Since the interpretability of extracted principal components can be improved and trends can be made more apparent with the use of rotation, varimax orthogonal rotation was performed and comparisons were made between the rotated and the non-rotated results. The number of components to extract and retain in the analysis were based upon

both traditional methods such as Kaiser's rule and Cattell's scree test as well as more modern methods such as parallel analysis, optimal coordinates, and acceleration factor methods. Two methods were applied to correct for missing data in the standardized CSA scores, listwise deletion and mean imputation. As PCA is highly impacted by missing data, the results of both were compared to detect trends in the CSA scores and redundancy in the eight assessments for this sample of first-attempt NCLEX failures.

Summary of Findings

Overall, the PCA indicated that two nearly distinct components could account for a considerable amount (60%) of variation in eight standardized CSA scores of students failing NCLEX on their first attempt. Most of the assessments exhibit a great deal of redundancy among first time NCLEX failing students. Additionally, two of the assessments, pharmacology and adult medical-surgical, seem to be particularly correlated to one another and less so to the other content specific assessments.

In summary, the results showed that the two-component model was the best fit for the observed sample data and that PCA techniques can reduce the observed CSA scores to only two principal components, emphasizing the redundancy present in the CSA areas.

Recommendations

The findings of this study could have several implications for nursing education. The redundancy detected could lead nurse educators to reconsider the implications of a number of CSA provided throughout a program of study and focus on specific content areas such as, adult medical-surgical and pharmacology, to identify at risk students. The PCA showed these two CSA seem to cluster together and not necessarily with the other CSA. These CSA could possibly predict NCLEX failures at a higher rate than the others. Discovery of a significant relationship

between CSA scores and prediction of NCLEX failure can assist faculty in identifying the students at risk, inform selection of CSA for faculty and act as a factor worthy of investigation for decreasing NCLEX failures. The follow-up study to this work will test such a hypothesis and warrants further study.

In addition, the procedure utilizing PCA as a reduction model warrants further consideration as a means for analyzing relationships of standardized assessments to NCLEX failures.