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Improving Health Science Faculty's Comprehension of Test Item-Analysis

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Problem: Within the three-campus Practical Nursing Program at a small, community college, an increase in students' complaints of test grades led to the discovery that each Instructor in the program possessed differing testing practices. Revealed variations included test-item sources (hand-written versus publisher test banks), levels of Bloom's taxonomy, and grading of exams. The need for testing consistency was highlighted as the faculty began to prepare for an Accreditation Commission for Education in Nursing (ACEN) site visit. Thus, the problem of Faculty's lack of knowledge of test item-analysis arose. A literature review demonstrated that the problem was prevalent throughout the health science education community, leading to the PICO, "Will the Faculty of the Health Sciences Department of a small community college self-report greater knowledge of and confidence in test-item analysis after an educational activity?".
Purpose: This organization-sensitive, quality improvement DNP project investigated how the impact of an educational intervention on multiple choice question (MCQ) test-item analysis on the Faculty of the Central Georgia Technical College (CGTC) Health Sciences Department.
Goal: The goal for the project was that students would receive quality health sciences education based on evidence-based practices.
Objectives: Upon attending an education session on test item-analysis, Faculty would self-report an increase in comprehension of, confidence in completing, ability to overcome barriers to incorporating, and intent to incorporate test item-analysis into their curricula. Further, following the education intervention, Faculty would correctly analyze a practice test item to include the following components: item difficulty, item discrimination, and plan for future item use.
Plan: A quality improvement project proposal approval was obtained, and upon receipt of CGTC and Regis IRB approvals, from March 2021 to early-April 2021,11 one-hour educational sessions on test item-analysis were offered via the CGTC learning management platform, Blackboard Collaborate. Each session began with a pre-intervention survey and concluded with a post-intervention survey. Each survey included a practice test item for participants to analyze. Data was collected and analyzed mid-April 2021.
Outcomes/Results: Seven faculty participants attended an education intervention session and completed both pre-test and post-test surveys, including the practice test items. No data was discarded for incomplete responses. Paired samples t-test analysis revealed a statistically significant post-test increase in participants' knowledge of ($t = -2.828$, $p = .030$) and confidence in completing test item-analysis ($t = -3.87$, $p = .008$). A statistically significant post-test increase was also noted in participants' ability to overcome barriers to implementing test item analysis into their curricula ($t = -2.828$, $p = .030$). The fourth objective, intent to implement, was only included in the post-test survey. Frequency count results were neither agree or disagree = 1(14.3%), agree = 1(14.3%), and strongly agree = 5(71.4%). Objective five evaluated participants ability to correctly complete a practice item. A statistically significant increase in the ability to correctly identify one component of the item analysis, item discrimination ($t = -2.828$, $p = .030$) was noted. However, frequency counts revealed an increase in the total number of correct analyses responses, pre-test = 2(14.3%) and post-test = 3(43%). Overall, the data analysis supported the positive impact of education on the knowledge of, confidence of Health Science Faculty in performing test item-analysis, as well as their intent to implement test item-analysis into their curricula.

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Improving Health Science Faculty's Comprehension of Test Item-Analysis

Every health professional is required to undergo some manner of testing to validate learning prior to becoming licensed to practice. Health educators are tasked with the responsibility to prepare students for these regulatory exams. Student assessment and evaluation are necessary and vital components of the preparatory process. As such, educators should make every effort to ask questions in a manner that accurately reveals the quality of student learning. Such a task, however, is one which many educators find difficulty achieving. In a 2018 convenience study of 674 Nurse Educators across the United States, 55% reported writing test items "from scratch" (Bristol, Nelson, Sherrill, & Wangerin, 2018, p. 71). This practice has been associated with poor quality questions that may be too easy, too difficult, or simply fail to adequately evaluate students' knowledge (Rush, Rankin, & White, 2016). Bristol, et al. (2018) revealed that most Educators reported no testing policy or practices to ensure quality, validity and reliability of their test items or questions. This project sought to examine the testing procedures within the Health Sciences department of a small community college, Central Georgia Technical College, for possible variations in testing and evaluate the impact of education of an evidence-based practice (test item-analysis) on Health Science Educators.

Problem Recognition and Definition

Problem Statement

Many times, in adult education, industry experts are hired to teach and prepare students to practice in their various fields. This fact is true of healthcare as well. While one's years of experience and education may deem one an expert in a field (nursing, pharmacy, radiology, physical therapy, etc.), such expertise does not automatically equip one to teach others. As such, these expert care providers are often novice educators and may not be adequately prepared, or

interested in, ensuring that evidence-based practices (EBP) are embedded in curricula design and implementation. One implication of this lack of knowledge or interest in EBP reveals itself in the lack of testing policies, which include developing test blueprints, per-item timing and the focus of this study, test-item analysis. One of the most common testing methodologies is the use of multiple-choice question items (Quaigrain & Arhin, 2017). Well-constructed multiple-choice questions (MCQ) allow for a confident assessment of student learning (Hiiji, 2017). Failure to provide quality student learning assessment and evaluation tools and methods can negatively impact both student and program outcomes. In its Vision Series statement, "A Vision for Doctoral Preparation for Nurse Educators", the National League for Nursing (NLN) (2013) asserted the need for nurse educators in fostering clinical reasoning skills in nursing students in anticipation of meeting the new and emerging challenges of today's healthcare delivery systems. This need for clinical judgement, clinical reasoning and critical thinking is not isolated to nursing students, but essential to all health care providers. Per the NLN (2013), doctorally-prepared nurses are specifically prepared to "to develop and incorporate evidence-based approaches" in nursing education (p. 2). This purpose of this organization-sensitive, quality improvement DNP project was to investigate how an educational intervention on multiple choice test-item analysis would impact the Faculty of the Central Georgia Technical College (CGTC) Health Sciences Department. More specifically, "Will the Faculty of the Health Sciences Department of a small community college self-report greater knowledge of, increased confidence in completing, and intention to implement test-item analysis after an educational activity?"

Project Scope and Significance

The scope of this project was to identify the impact of test-item analysis as an educational intervention within the Health Sciences department at Central Georgia Technical College.

Greater validity and reliability in testing, as evidenced by test-item analysis, promote greater reflection of student learning, with the goal of increased student competence in providing safe, knowledgeable, care. Improved consistency in testing among program faculty via a program testing policy is a by-product of this project as the literature is replete with evidence of the negative impact of testing inconsistencies and lack of a test policy.

Theoretical Foundations

Bandura's Social Cognitive and Self-Efficacy Theory asserts that intrapersonal change is influenced by not only knowledge or cognition, but also environmental and personal, or behavioral, factors (Pajares, 2002; Bandura, 2004). Per Bandura, the most influential of these factors is the belief in one's ability to accomplish a task, self-efficacy (Pajares, 2002; Bandura, 2004). Social Cognitive Theory provided the primary theoretical foundation for this DNP project. Faculty's self-perceptions of their abilities to complete item-analysis greatly impact their abilities to do so. Prior or lack of previous exposure to item-analysis, as well as faculty's perception of the value or importance of item-analysis each impact their approach to the concept.

Secondly, Kurt Lewin's Theory of Change maintains that three steps must be fulfilled before participants will embrace change (Burnes, 2004). For test item-analysis to become the norm within the CGTC Health Sciences Department, Faculty will need to be willing to let go of beliefs that impact their behaviors as Educators (unfreezing). They must be motivated to learn about the rationale for and the application of item-analysis (moving) (Burnes, 2004). Finally, Lewin insists that successful organizational change must occur at the group level (Burnes, 2004). As such, for item-analysis to become a normal component of Health Sciences curricula, all Faculty must embrace and participate in the change.

The third theoretical framework upon which the project was based is Knowles' Andragogy, which states that adult learning must be self-directed, experience-based, and problem-focused (Knowles, Holton III, & Swanson, 2015). For adult learners, new knowledge needs to have value. For this population, new information needs to be applicable to real-life situations to be deemed useful (Billings & Halstead, 2016). This project's educational intervention sought to meet Knowle's three requirements for effective adult learning. First, faculty participation was voluntary in nature. Secondly, each participant had experienced administering exams and making decisions based upon the exam results. Lastly, discerning quality test items, that appropriately assess student learning, is a problem that all faculty experience.

Review of Evidence

An integrative review of the literature revealed that inadequate knowledge and use of evidence-based testing policies is an interdisciplinary problem world-wide. Keyword searches of CINAHL, PubMed, and ERIC databases for testing policy, item-analysis, multiple-choice questions, nursing faculty, test construction, test development, exams, and educational development resulted in 55,502 articles. Search criteria included years 2013-2018, peer-reviewed and English language.

A narrowed search limited terms to nursing faculty, test construction, multiple choice questions, testing policy, and item-analysis. Search criteria was expanded to include ProQuest and ScienceDirect, and years 2015-2020. One source, NLN, was retrieved from a Google search. Thirty-one articles were included in the final analysis. Most of the articles (19) were descriptive in nature and were evaluated using Melnyk's seven levels of evidence (Polit & Beck, 2012). Three articles were single, non-randomized controlled trials. Five were single randomized

controlled trials. One systematic review of correlational /observational studies was found. Fourteen were level six, single, descriptive/qualitative studies, while the remaining four were opinions of authorities or expert committees.

Of the 31 articles, 25 were studies on the impact of an educational activity on EBP testing practices, such as item-writing, and each resulted in an increase in Faculty's self-reporting of comprehension of EBP. Consistent throughout the literature was the lack of knowledge in evidence-based practice, lack of knowledge and confidence in writing multiple choice questions, lack of time and administrative support for Faculty education on item-writing, and lack of program test policies. These findings were consistent not only among nursing faculty, but also within other healthcare disciplines. In their randomized control trial, Dellinges and Curtis (2017) realized a significant improvement in knowledge and confidence in writing multiple choice questions and item-analysis among dental school faculty after a one-hour educational session. Webb, Phuong, and Naeger (2015) found that 68% of 400 multiple choice items written for radiology students contained some type of flaw. In their longitudinal study on the impact of education on test item writing, Abdulghani, Irshad, Haque, Ahmad, Sattar, and Khalil (2017) discovered a significant difference not only in faculty knowledge, confidence in, and application of evidence-based practices, but also student outcomes. Alamoudi, El-Deek, Park, Al Shawwa, and Tekian (2017) found similar results in their long-term study of the impact of education on medical school faculty.

A second emerging theme arising from the literature review was the need for a program testing policy. Inconsistency in test item types, coupled with faculty ignorance of or lack of application of evidence-based practices facilitate the need for test policy (Birkhead, 2018). Self-reliance in test development is common among faculty, further supporting the need for

programmatic test policy (Bristol, et al, 2018). Implementing a test policy reduces both self-reliance and inconsistency in testing, as well as promotes better outcomes through the implementation of evidence-based practices, such as test item-analysis (Coddington & Karsten, 2014). Schroeder (2013) also found that implementing a test policy improved NCLEX-RN® pass rates. The need remains for faculty's increase in confidence in and the commitment to incorporate EBP into curricula. See Appendix A for a sample of the Systematic Review of Literature.

Market Risk Analysis

Strengths, Weaknesses, Opportunities, and Threats

Several strengths of this project were identified in the market risk analysis. All faculty were healthcare professionals and familiar with the importance of knowledge attainment and application. All programs had a licensing exam. The college had a learning management system for which all faculty were required to use in their curricula. No extra training for technology was required. Health Sciences Department Leadership (Dean, Associate Dean, Directors, and Program Chairpersons) worked closely with their respective Advisory Committees. Finally, successful adoption could lead to the creation of health sciences department test-policy committee.

The primary weakness of the study was the potential lack of time to attend the intervention. A CGTC IRB condition of approval was that the intervention be conducted outside of work hours. As such, the intervention was offered in the evenings during the work-week and on weekends. Per participant feedback, additional sessions were offered during the workday lunch-hour and immediately upon close of business, prior to faculty leaving their offices. A second weakness that may have impacted the number of participants was Faculty's potential

previous exposure to the intervention content, as a session on test-item analysis was offered on a mandatory Professional Development day. Further, Nursing Faculty had begun completing test analysis on exams as a requirement for accreditation. Either or both exposures may have impacted the study's results.

External opportunities included the need to meet regulatory and accrediting agencies' licensing and certification requirements. Further, community healthcare providers' expectations of graduates can impact curricula. Central Georgia Technical College has a robust economic and workforce development relationship with many surrounding community businesses and industries, which rely on the production of "a well-qualified, highly trained, knowledgeable workforce" (CGTC, 2017). As such, the College's brand and reputation within the community is directly impacted by students' success. The College has fostered multiple articulation agreements with other local and state colleges, each of which are contingent upon the quality of the school's education standards.

While collaboration with other colleges provides opportunities, local colleges also posed a threat, as numerous colleges with Health Science departments exist in Central Georgia. Competition from these schools posed threats to student enrollment, as well as community contracts and collaborations.

Driving and Restraining Forces

The need for safe, competent, and knowledgeable healthcare practitioners in the community was the primary driving force for this study. Secondly, retention, graduation, and licensure rates all impact potential state and federal funding for the College. Per the CGTC Executive Director of Institutional Effectiveness, CGTC received an additional allotment of state funds for the highest number of graduates within the Technical College System of Georgia

(Bonnie Quinn, personal communication, March 26, 2021). Improving these rates increase revenue as wells as marketability for the College. As anticipated, lack of faculty participation was the major restraining force. Consistency and quality in testing throughout the Health Sciences department drove the need for this project.

Needs, Resources, and Sustainability

Resources necessary for implementation of the project were Blackboard, as a platform for sharing the content with faculty, faculty's access to a computer, and faculty's willingness to participate in the intervention and to complete the pre- and post-test surveys. As all faculty have computers in their work offices and are required to use Blackboard as their learning platform, sustainability of this project is not only feasible, but encouraged by participants, Health Science Leadership, and by the Office of Institutional Effectiveness.

Feasibility, Risks, and Unintended Consequences

Reproducibility of this project is highly feasible. While the intervention was administered via a learning management system and an electronic survey platform, the project can be implemented without these specific means. As such expenditures and supplies should not hinder reproduction of the project. Risks associated with failure to implement the intervention include poor test validity and reliability; assessment of student learning; student learning outcomes (retention, graduation, and licensure rates); patient care; and college reputation. While implementation of the project intervention was expected by the Health Science Faculty, one unintended consequence realized was the request to disseminate the educational session to the entire college faculty.

Stakeholders and Project Team

Zaccagnini and White (2017) identify stakeholders as anyone who may be impacted by outcomes of the project. As such, primary stakeholders were Central Georgia Technical College Health Sciences Faculty, as they were the beneficiaries of the knowledge gleaned from the intervention and would be responsible incorporating item analysis into their curricula. Additional stakeholders were students, as the implementation of item-analysis promotes improvement in assessment of learning, and subsequently, improvement in teaching and evaluation methodologies. As teaching, learning and evaluation improve, retention, graduation and licensure exam pass rates should improve, all of which will benefit the college as an organization. CGTC is one of several local colleges. High student success rates can generate greater partnerships among healthcare providers and the College. Improvement in student learning should yield better healthcare client outcomes, and which will also positively impact future employers. Thus, the healthcare community was the final stakeholder in this project.

Team members for this DNP project included T. Love, DNP student; Dr. D. Bell, Project Mentor (primary); Mrs. F. Wimsatt, MSN-Ed., Project Mentor (secondary); and Dr. L. Claywell, Project Chairperson; B. Quinn, CGTC Executive Director for Institutional Effectiveness; Dr. A. Harmon, Dean, Health Sciences Division; and Dr. C. Rumney, CGTC Dean of Distance Education provided expertise assistance with instrument validity, content validity and use of the learning management system, Blackboard Learn.

Cost-Benefit Analysis

The primary costs associated with this project were faculty's salaries for one-hour of attending the intervention ($252 for seven participants). Development of the intervention by the investigator took approximately eight hours, at a cost of $240. A one-month subscription of SurveyMonkey as the platform form the project's consent, pre- and post-tests, and data

collection costs $32; and use of the intervention platform, Blackboard, had an estimated cost of $8300 for ten one-hour sessions at approximately $83 per hour (Survey Monkey, 2020; Betterbuys, 2019). Finally, a six-month subscription to IBM SPSS for data-analysis cost $49 (IBM, n.d.) See Appendix B for project-associated costs.

Benefits of the project far outweigh the costs, as previously identified in the stakeholder discussion. These benefits include those of faculty knowledge, satisfaction, and confidence, each of which promote faculty retention. While the total potential cost for project intervention was $1454, the cost of replacing one faculty member could be as high as $75,000 to $100,000. A second benefit of this project entails improved achievement of program student learning outcomes via better teaching and assessment methods: increased student retention, graduation, licensure, and job placement rates. Each of these achievements potentiate positive patient outcomes and promote positive college-community relationships.

Project Objectives

Mission, Vision, and Goals

The vision of this project was to investigate the impact on quality of instruction in the Health Sciences department via the implementation of test item-analysis. The mission was to increase Faculty's knowledge and application of test item-analysis, with an overarching goal of curriculum changes leading to positive student outcomes via high-quality health sciences education rooted in evidence-based practices.

Outcomes Objectives

Four objectives were originally determined for the project. However, upon data analysis, a fifth objective arose. Objective one was to increase faculty's self-report of knowledge of test item-analysis via a one-hour educational in-service. Objective two was to increase faculty's self-report

of confidence in completing test item-analysis after a one-hour educational in-service. The third object was that faculty would self-report ability to overcome barriers to test item-analysis after a one-hour educational in-service. Objective four was that faculty would self-report intent to implement test item-analysis in their curricula after a one-hour educational in-service. Finally, objective five was that faculty would correctly analyze a practice test item-analysis, identifying item difficulty, item discrimination, and plan for future item use after a one-hour educational in-service.

Project Plan and Evaluation

Logic Model

The identified problem for this project is the lack of Faculty knowledge of and confidence in performing test item-analysis. The following discusses the components of the logic model for this problem statement. See Appendix C for the visual depiction of the logic model.

For successful implementation, resources, or inputs, must be addressed. For most faculty, time is a limitation in the participation of many extra-curricular activities. Faculty must be provided adequate time to participate in the both the pre-test/post-test surveys, as well as the educational activity. To respect and maximize use of the faculty participants' time, the educational activity, including the pre-test and post-test, was limited to one-hour. Other necessary inputs included the need for administrative support from the Dean of Health Sciences and respective Program Chairpersons to allow time for participation. Further, administrative support in the form of encouragement of faculty participation, without retribution for non-participation, was expected to facilitate success. Because the intervention was housed within the College's learning management system, approval from the Executive Director of Distance Education was sought. All Faculty have office computers, and all are required to have had prior

training on the use of the learning management system (LMS). The LMS is a required component of all college courses. Therefore, funding needs for the project were minimal, if any. All aspects of the study were completed via computer: both the survey (via Survey Monkey) and the presentation, which were both be available for download from the LMS session and emailed to all faculty for future use after the intervention. No paper or any other physical items were required for participation nor data collection. The greatest need for this study was Faculty participation. All faculty, regardless of program type (nursing, radiology technician, physical therapy tech, etc.) completed the same survey tool and received the same education. Constraints to project success and adoption of the intervention included Faculty participation and Faculty buy-in, and the time required to complete the test item-analyses, respectively. However, because constraints to intervention implementation are minimal, generalizability and sustainability are favorable.

The educational intervention for this study was a presentation on the purpose, use and benefits of test-item analysis, including example items and suggestions for practical application. As previously discussed, the educational activity was held as a live, synchronous session within BlackBoard Collaborate, the college's LMS. Faculty were emailed an invitation with a link to the session, including the date and time. Faculty were able to participate by simply viewing the presentation on their respective computers. The pre-test and post-test surveys were embedded within the Collaborate session. Faculty were completely anonymous throughout the entirety of the presentation, including survey completions.

Upon completion of the educational intervention, Faculty should report improved comprehension of and confidence in performing test item-analysis. Further, Faculty will have identified barriers to incorporating test item-analysis.

The expected outcomes of Faculty adoption and application of test item-analysis to assess quality of evaluation tools are multi-faceted. Goals for implementation are that Faculty will develop higher quality evaluation methods. Faculty will use exam results to guide curriculum development and change. Students' exam results will be more reflective of actual learning, and students will improve in critical thinking and application of knowledge. Appendix D provides a conceptual diagram of the project's inputs and outcomes. Appendix E provides the timeline for the project.

The long-term impacts of the adoption of test item analysis in the Health Science Department are also multi-fold. The Health Science Department will develop a culture of using evidence-based practices in curriculum development and evaluation methods. Students will be better prepared for their respective regulatory exams due to quality preparatory exams. Finally, the CGTC Health Science Department will realize higher graduation, student licensing and job placement rates.

Each of these identified goals and outcomes are based on the assumptions that (1) Faculty want to utilize effective evaluation tools, (2) Faculty want to understand the purpose of test item-analysis and (3) Faculty want to provide every opportunity to facilitate students' success, as well as meet the mission and vision of the college.

Population and Sampling Parameters

Faculty of the Health Sciences Department of a small community college attended a forty-five-minute educational session on test item-analysis, which served as the independent variable. Of greatest importance to the researcher is the dependent variable, or the intended outcome of the study (Terry, 2018). The primary outcome measured by this project was the self-

reported increase in the knowledge of and confidence in performing test item-analysis by the Health Science Faculty.

Extraneous variables are factors beyond the independent variable that may influence the study's outcome, or dependent variable (Polit & Beck, 2010). Relationships between the independent and dependent variables may be difficult to ascertain due to extraneous factors. For example, the education level of Faculty members may influence the effectiveness of the education session on their knowledge and confidence level. Faculty members who have had organized education in an advanced degree nursing program may self-report differently from those whose first exposure to test item-analysis occurs during the education intervention. Other extraneous variables that may affect the outcome of this study include length of teaching experience and Faculty's underlying belief systems regarding the incorporation of evidence-based practices.

While randomized sampling is associated with the least risk for bias, convenience sampling was the most feasible sampling type for this study. Per Terry (2018), convenience sampling is most suitable when the population is limited to participants who are readily available and most willing to participate in the study. Terry (2018) recommends that the entire population be included in the study when the population is less than 100 people. Further, because of the similarity in the characteristics of the Health Science Faculty, Terry (2018) also recommends that a smaller representation of the population be chosen due to homogeneity. Finally, for a confidence interval of 95% and 5% margin of error of deviation of the sample mean from the population, the entire population of 66 faculty were invited to attend the educational session, with accompanying pre-test/post-test surveys (Select Statistical Services, 2019; Terry, 2018). As

such, a convenience sample of seven Central Georgia Health Science Faculty volunteered to attend the sessions and complete the surveys.

Because this project did not test hypotheses, no power analysis was necessary.

Methodology and Measurement

Likert scales were used for the pre-test & post-test surveys. The surveys were administered via Survey Monkey. A Likert scale is commonly considered ordinal level. However, Polit and Beck (2018) assert that the data in this project was interval because the tools measured psychosocial self-efficacy prior to and following an intervention. Since the expectation was that the self-efficacy would increase after the intervention, the data was no longer continuous, and the rank was increased to interval. See Appendix F for the pre- and post-test survey tool.

Paired t-tests were used to compare participants' pre-survey data to post-survey data. The paired sample t-test identified pairs of variables with statistically significant differences as identified by a p value less than 0.05. The means of each pair of variables was identified using the paired samples statistics table.

Per Polit and Beck (2018), Pearson's Correlation is used to determine relationships among the variables at the interval level. Correlations were identified if the p value was less than 0.05, indicating statistically significant difference.

Finally, a frequency table with participant responses for each variable was created. Percent and frequency counts were used to quantify data that could not be compared pre- and post-intervention.

Human Subjects Protection

The population for this DNP project was a group of 66 Health Sciences Faculty. Based on the National Bioethics Advisory Committee's (Citi Program, n.d.) definition of vulnerability, population was not considered vulnerable. Each was well educated. There was no chance of coercion. There was no monetary or financial inducement. Participation was not required as a condition of employment or job-related benefits; participants are free to enter or leave the facility at will. There was no risk of physical harm or reward of gain for participating the study. Further, no risk of harm was associated with knowledge of each person's participation, should that information be unintentionally revealed. Strict anonymity was enforced, as participants were instructed to sign-in to the educational session with fictional names. Further, all cameras were turned off and all microphones muted. Participants were assigned a two-digit code for pairing of pre- and post-survey data. The only demographic data collected was number of years of teaching experience. All other data was collected in aggregate form.

No risk of violation of the ethical principles associated with consent exists with the study population. Each participant was fully autonomous to volunteer or not without coercion (Terry, 2018). Any real or perceived risks to participation prior to obtaining consent were addressed via informed consent. The primary risk to participating in the study arose from participants' concern with posttest scores, if unsuccessful.

Beneficence protects the participant from harm during the study, after consent has been obtained (Terry, 2018). The study design was pre-test/post-test, wherein participants completed a questionnaire on their knowledge of and self-reported confidence in performing test item-analysis before and after attending an educational session on item analysis. Data security entailed use of a password protected computer, to which only the DNP student had access.

This project was approved as one of quality improvement by the Institutional Review Boards of Central Georgia Technical College and Regis University. Per the Human Subjects Research determination of quality improvement project, as delineated by the Regis University Determination of Human Research Form for Quality Improvement/Quality Assessment Activities (Regis University, 2019), the purpose of this project was to improve a process within the Health Sciences Department. The primary intent of the project was not to expand knowledge of a scientific discipline. The intervention was an educational activity based on best practices identified in the literature. Although informed consent was not necessary for participation, an informed consent was provided. See Appendix G and H for CGTC and Regis University IRB approvals.

Instrument Reliability and Validity

One of the greatest concerns of quality research is the truthfulness of inferences made based on study results, or validity. Factors other than the independent variable may have affected the outcome (Polit & Beck, 2012). Differing types of research design each possess threats to both validity and reliability. Identified threats to the internal validity of this one-group pre-test/post-test design included maturation, history, timing, test sensitization, and mortality. Due to the nature of the study population, control of participant characteristics is very limited. Participants may have been exposed to test-item analysis prior to the planned educational intervention. Unfortunately, this potential threat was beyond the researcher's control, as was mortality of subjects. Faculty-participants may be lost over the course of the study due to changes in positions or resigning from the program. Testing was another threat that may have occurred, as participants' attitudes or knowledge may change as a direct result of sensitization, or exposure to the survey questions (Polit & Beck, 2015).

Reliability of the test instrument was also a concern. Measurement instruments should be able to produce similar results when applied to a similar group under similar conditions. One way to prevent this threat is to ensure a quality measurement tool. Submitting the tool for review by content experts may help to increase tool reliability. The tool employed was based upon one previously reviewed for content validity by a panel of experts. The tool was then adapted by adding a practice test item for participants to analyze in both the pre- and post-intervention surveys. Cronbach's alpha was used to measure internal consistency and reliability. While a Cronbach's alpha closer to 1.0 is preferred, a result greater than 0.5 is acceptable. The Cronbach alpha for the survey tool was 0.611, which may be contributed to several factors, including the sample size and differences in the pre and post questions.

Table 1

Reliability Statistics

Cronbach's Alpha for tool used	Cronbach's Alpha Based on Standardized Item	N of participants
0.611	0.873 (N = 6)	N=7

Data Collection and Treatment Protocol

Surveys were administered and data was collected via Survey Monkey. For each educational session, participants were asked to sign in to Blackboard collaborate using a fictitious name. Upon signing in, each participant was assigned a two-digit code for pre-test, post-test survey data pairing. Then, each participant was a link the Survey Monkey pre-test survey. Upon completion of the pre-survey, the education was provided. At the end of the education, participants were sent a second link to the post-test survey.

Upon the final session, data processing began. Data was verified for paired responses. No data was excluded. Each participant responded to each pre- and post-survey question. All data, including participant demographics, Likert survey responses, and practice item analysis responses, were entered into an Excel spreadsheet and coded. The coded data was then uploaded into SPSS-27 for analysis.

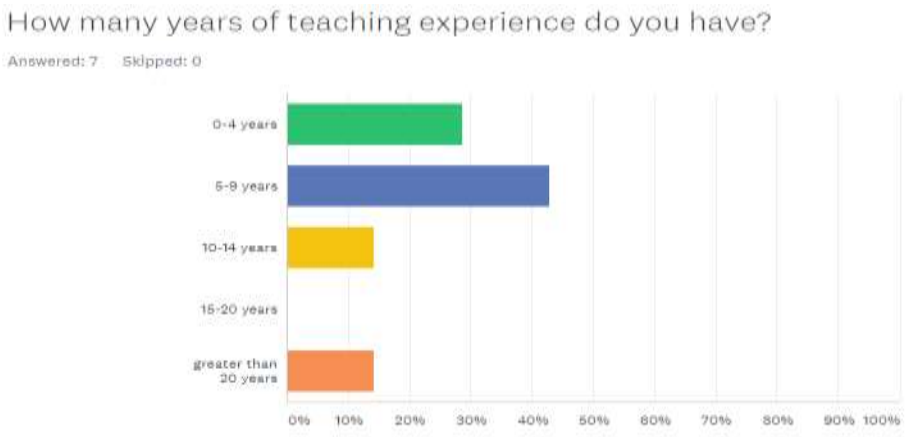
Project Findings and Results

Description of the Sample

Participants were asked to identify their number of years' teaching experience. Descriptive statistics were used to report findings. Two, or 28.6%, listed 0-4 years of experience; three, or 42.9%, listed 5-9 years of experience; one, or 7.1%, listed 10-14 years of experience; and one, or 7.1%, listed 15-20 years of experience. Figure 1 depicts the participants' demographic results.

Figure 1

Participant Demographics



Increased Knowledge of Test Item-Analysis

The paired sample t-test was used to identify pairs of variables with statistically significant differences as identified by a p value less than 0.05.

The means of each pair of variables was identified using the paired samples statistics table. Objective One was defined as a self-reported increase in knowledge of test item-analysis. Respondents reported a statistically significant increase in knowledge of item analysis following an educational intervention as evidenced by $p < .05$ (See Table 6).

Table 2

Objective 1: Paired Sample t-test

Variable	t Value	p Value	Mean	Percent change between pre and post means
Increased Knowledge	-2.828	.030	Pre: 4.14 Post: 4.71	+7.25%

Descriptive statistics were used to explain pre-test/post-test outcomes aggregates. Four participants (57.1%) reported "agree" to increased knowledge following the education session. Three participants (42.9%) reported "strongly agree" to increased knowledge post-intervention.

Increased Confidence in Completing an Item-Analysis

Objective Two was defined as a self-reported increase in confidence in completing test item-analysis. Respondents reported a statistically significant increase in completing item analysis following an educational intervention as evidenced by $p < .05$ (See Table 7).

Table 3

Paired Sample t-test: Objective 2

Variable	t Value	p Value	Mean	Percent change between pre and post means
Increased Confidence	-3.87	.008	Pre: 3.86 Post: 4.57	+18.39%

Outcome aggregates for objective two revealed one participant (7.1%) reported neither agree nor disagree in increased confidence following the education intervention. Four

participants (64.3%) reported “agree” to increased confidence and two participants (28.6%) reported “strongly agree” to increased confidence post-intervention.

Increased Ability to Overcome Barriers to Implementing Item Analysis

Objective three was defined as a self-reported increase in ability to overcome barriers to completing test item-analysis. Respondents reported a statistically significant increase in ability to overcome barriers to analysis following an educational intervention as evidenced by $p < .05$ (See Table 8).

Table 4

Paired Sample t-test: Objective 3

Variable	t Value	p Value	Mean	Percent change between pre and post means
Increased Ability to Overcome Barriers to Implementation	-2.828	.030	Pre: 3.86 Post: 4.43	+14.77%

Intent to Implement Test Item-Analysis into Curricula

The fourth objective, intent to implement, was only included in the post-test survey. 71.4% of participants reported that they strongly agreed to implement test item-analysis into their curricula (See Table 9).

Table 5

Objective 4: Post-test Frequencies

Variable	Neither	Agree	Strongly Agree
Intent to Implement into Curricula	1(14.3%)	1(14.3%)	5(71.4%)

Ability to Correctly Analyze a Practice Test Item

Objective five evaluated participants ability to correctly complete a practice item, including the three individual components: item difficulty, item discrimination, and plan for item

use. A statistically significant increase in the ability to correctly identify only one component of the item analysis, item discrimination ($t = -2.828$, $p = .030$), was noted. However, frequency counts revealed an increase in the total number of correct analyses responses, pre-test = 2(14.3%) and post-test = 3(43%). Frequency counts for objective five are provided in Appendix

Correlations

Per Polit and Beck (2018), Pearson's Correlations are effective in determining relationships among the variables at the interval level and was used to analyze the pre-and post-survey results, including responses to the practice items. Four sets of variables that were found to have statistical significance. A negative correlation was seen between two pre-survey practice item analysis components, variables "pre-discrimination" and "pre-plan for use" ($r = -0.887$, $p = .008$). This finding may indicate that participants had trouble identifying correct responses to these components of the practice item. A second negative correlation was noted between a pre-survey practice-analysis variable, "pre-plan for use", and post-survey variable, "postQ1" ($r = -0.849$, $p = .016$), indicating that participants may have not fully understood the purpose of the pre-variable prior to the education. The pre-survey "years of experience" was found to have negative correlations to two post-survey variables. First, "pre-years of experience" and "postQ1" ($r = -0.849$, $p = .016$) reflected that years of teaching experience may have negatively impacted participants' post-education knowledge. Secondly, "pre-years of experience" and "post-difficulty" ($r = -0.867$, $p = .011$) further supported the relationship between years of experience and ability to correctly complete an item analysis.

Discussion

Three of this project's five objectives were met with statistically significant self-reported improvements following the educational intervention. Overall, faculty reported increases in

knowledge of test-item analysis, confidence in completing an item analysis, and the ability to overcome barriers to implementing item analysis in their curricula. These findings are consistent with the evidence review. Although the intent to implement test item-analysis into curricula was only asked in the post-test survey, 71.4% of respondents strongly agreed that they would do so following the intervention. The final objective was that faculty would correctly perform a practice item-analysis, identifying the individual components of item difficulty, item discrimination, and plan for future item use. Although the changes in pre- and post-test results were not of statistical significance, frequency counts revealed that more participants responded correctly following the education than prior to the intervention. Overall, the project provided a positive response to the PICO question: The faculty of the Health Sciences Department of a small community college self-reported greater knowledge of and confidence in test item-analysis after attending an educational activity.

Limitations, Recommendations, and Implications for Change

Limitations

Several limitations to this project exist and may have impacted outcomes. Seven of 66 faculty attended the education sessions and completed both the pre- and post-surveys. This limited response rate may not have accurately reflected the Health Science faculty.

Secondly, prior exposure to test item-analysis may have influenced results. While the eligible population included all Health Science Faculty, the sample may have consisted of nursing faculty, who had already begun to incorporate test item-analysis into their testing practices.

The question, “intent to implement into curricula” was only asked in the post-survey. Asking the question both prior to and following the intervention may have provided a better comparison of intentions, allowing for test of statistical significance of results.

A fourth limitation arose from the pre- and post-survey practice item analysis questions. While the components of the analysis (item difficulty, discrimination, and plan for future use) where the same, the results upon which the analysis were completed where different. Thus, the pre- and post-practice questions were not the same, limiting the ability to accurately compare results.

Implementing the project during the COVID-19 pandemic presented challenges. Although the pre- and post-surveys, as well as the intervention were all administered via computer, changes in faculty workloads and work schedules may have impacted participation. CGTC IRB required sessions to be held outside of work hours. Eleven sessions were offered in the evenings and weekends. However, the highest participation occurred within sessions that were held during lunch hours and immediately upon “close of the business day”.

Finally, the objective, “ability to overcome barriers to implementation of test item-analysis” may have limited important data collection. Asking participants to identify perceived barriers to implementation may have provided more robust discussion, allowing for exploration of methods to overcome said barriers.

Recommendations

The implications of test item-analysis in health science education warrant further research. Increasing the sample size can support the significance of the study and can be achieved by increasing the population to an entire college faculty or to other universities. Consistency in pre- and post-practice analysis items is highly recommended to achieve greater

reliability of survey tool and analysis of survey results. Lastly, gathering more participant demographic data is recommended. Assessing participants' beliefs about test item-analysis, as well as factors such as prior exposure and perceived barriers to implementation of item analysis can offer greater insight into faculty's testing practices. Gleaning this information can facilitate change within those practices.

Implications for Practice

Unlike many other disciplines, health science students' knowledge, comprehension, and ability to apply information has direct and dire potential consequences. Educators are responsible for ensuring both quality instruction and quality evaluation of student learning. Implementing test item analysis provides a reliable, evidence-based method of assessing quality of test questions, improving reliability of said questions, and more distinct reflection of learning. As such, the implications of test item-analysis are far reaching. Item-analysis allows for transparency in testing practices. When supported by a program testing policy, item analysis promotes consistency and provides guidance for faculty decisions about questionable test results.

Conclusion

Inconsistency in testing practices frustrate students. Inappropriate evaluation of student learning can negatively impact not only students, but also student and program learning outcomes, such as retention, graduation, licensure, and employability rates. Stakeholders, such as colleges/universities and community partners are affected by these results of student. Ultimately, future patients and clients are most directly affected by student learning, or lack thereof. This paper discussed the use of test item-analysis as an evidence-based method of promoting positive student and health science program outcomes. Education on the purpose, benefit, and method of completing test item-analysis was provided to health science faculty. Data analysis reflected an

overall improvement in participant's knowledge of, confidence in completing, and ability to overcome barriers to implementing test item-analysis. Further, faculty reported their intent to implement and improved ability to complete item-analysis. As such, further education, encouragement, and support for implementation of test item-analysis in health science programs is recommended.

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Appendix A

Objective 5: Practice Question Aggregates

Practice Question Aggregates (pre/post)

Variable	Frequency	%	Response
Difficulty	5	35.7	Easy
	3	21.4	Average/medium
	6	42.6	hard
Discrimination	3	21.4	poor
	9	64.3	Agree
	4	28.6	Strongly agree
Plan for Use	2	14.3	Neither agree nor disagree
	8	57.1	Agree
	4	28.6	Strongly agree

Appendix B

Systematic Review of Literature Sample

#	Article/Journal	Author/Year	Database/ Keywords	Research Design	Level of Evidence	Study Aim/Purpose	Population /Sample size Criteria/ Power	Methods/Study Appraisal Synthesis Methods	Primary Outcome Measures/Results	Conclusions/ Implications	Strengths/ Limitations	Funding Source	Comments
1	Effectiveness of longitudinal faculty development programs on MCQs items writing skills: A follow-up study. *PLOS ONE*	Abdulghani, H. M., Irshad, M., Haque, S., Ahmad, T., Sattar, K., & Khalil, M. S. (2017).	Pubmed. Keywords: *nursing faculty, test construction*, 2013-2018	Post-test	Level II: Single non-randomized trial	Examine the effects of longitudinal faculty development workshop training on MCQ test items writing outcomes and its influence on overall performance of the students.	58 faculty participants	Participants attended a one-day workshop each semester from 2012–2015. The MCQ items written by the academic faculties during the academic years 2012–2013, 2013–2014 and 2014–2015 were considered and included for the quality assessment. Before MCQs were administered to students, they were evaluated by an examining board for quality, as part of follow-up from the workshops. The quality of the MCQ items was evaluated in terms of construction (Bloom's taxonomic cognitive levels and presence/absence of the item writing flaws (IWFs)), MCQs items analysis ((Difficulty index (P), Discriminating index (DI), non-functioning distractors (NFDs), and test reliability (Kr20)), and student's performance (mean score and overall passing rate). Question Mark Perception Software Program was used for the items' analysis and for the determination of the test reliability.	A total of 2207 MCQ items were used to measure the main outcomes: The present study lies in the fourth level of the Kirkpatrick's model, which evaluates the changes among the participants' performance based on the MCQ items writing outcomes at three different levels. The reliability co-efficient (Kr-20) of MCQ items of all the eight courses increased from ≥ 0.88 in the academic year 2012–2013 to ≥ 0.92 in the academic year 2014–2015. Students' mean score decreased from 80.18% to 74.32%. The percentage of easy questions decreased, and the percentage of moderate questions increased. The P-value was significantly improved during each successive academic year. Bloom's taxonomic cognitive levels increased and the IWFs significantly decreased by the third year.	Faculty development training workshops have significant impact on the participant's MCQs item writing skills as demonstrated by improved test item's quality revealed by the students' assessment during each academic year, and the items' quality was continuously progressing in the successive academic years. Faculty reported feeling more experienced and skilled in constructing high quality MCQ items after attending the workshop.	Limitations: Willingness of faculty to participate in the workshop and to follow MCQ guidelines.	The financial support for this study was provided by the COM, Research Centre, Deanship of Scientific Research, KSU, Riyadh, Saudi Arabia	1. Appendix S1: Guidelines for avoiding the common item writing flaws in multiple-choice questions. 2. Study on medical students 3. Supports PICO! 4. Themes – (a) Faculty development: knowledge, confidence & behavior (b) MCQ item analysis
2	ACEN Accreditation Manual: 2017 Standards and Criteria	Accreditation Commission for Education in Nursing. (2017).	N/A	N/A	Level VII: Opinion of authorities or expert committees	N/A	N/A	N/A	Identifies and defines guidelines for student assessment and evaluation.	N/A	N/A	N/A	N/A
3	Evaluating the long-term impact of faculty development	Alaqeeli, A. A., El-Deek, B. S., Park, Y. S., Al Shawwa, L.	CINAHL. Keywords: *nursing faculty, test developme*	Cross-sectional study design	Level II: Single RCT	Examine long-term differences in confidence, knowledge, behaviors, and	61 Faculty members	24-item survey administered to faculty. Topic areas: (1) attendance in FDP sessions on MCQ item analysis, (2) attitudes and beliefs (confidence) towards MCQ item analysis and	Of the 61respondents, 34% did not attend FDPs; 53% attended 1–3 FDPs; and 13%	Attending FDPs on MCQ item analysis can significantly improve faculty confidence,	Limitations: (1) Self-reported data from participants.	Dr. Hanan Alkhalil, Chair for	1. Study on medical students 2. Study #1 fulfills some of

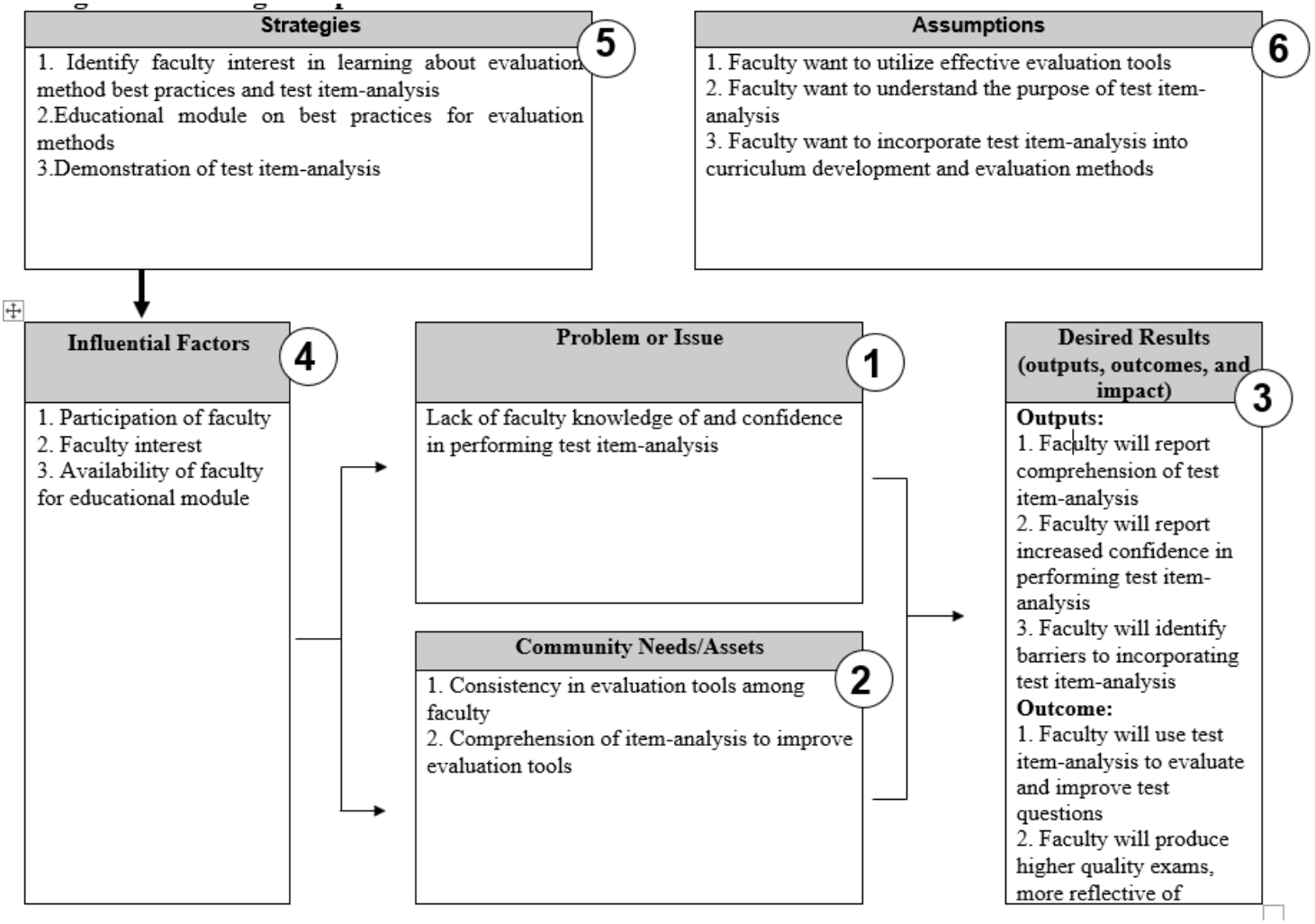
Appendix C

Budget and Resources

Resources		**Cost**
Faculty Participation (Avg Salary*One hour*36)		$1050
Module Development (8 hr preparation)		$240
Intervention Platform: CGTC Blackboard ($160K/yr)		$83/hr
Pre-test/Post-test surveys (Survey Monkey monthly subscription)		$32
Data Analysis (SPSS for Windows 10 annual subscription)		$49
	Total	$1454

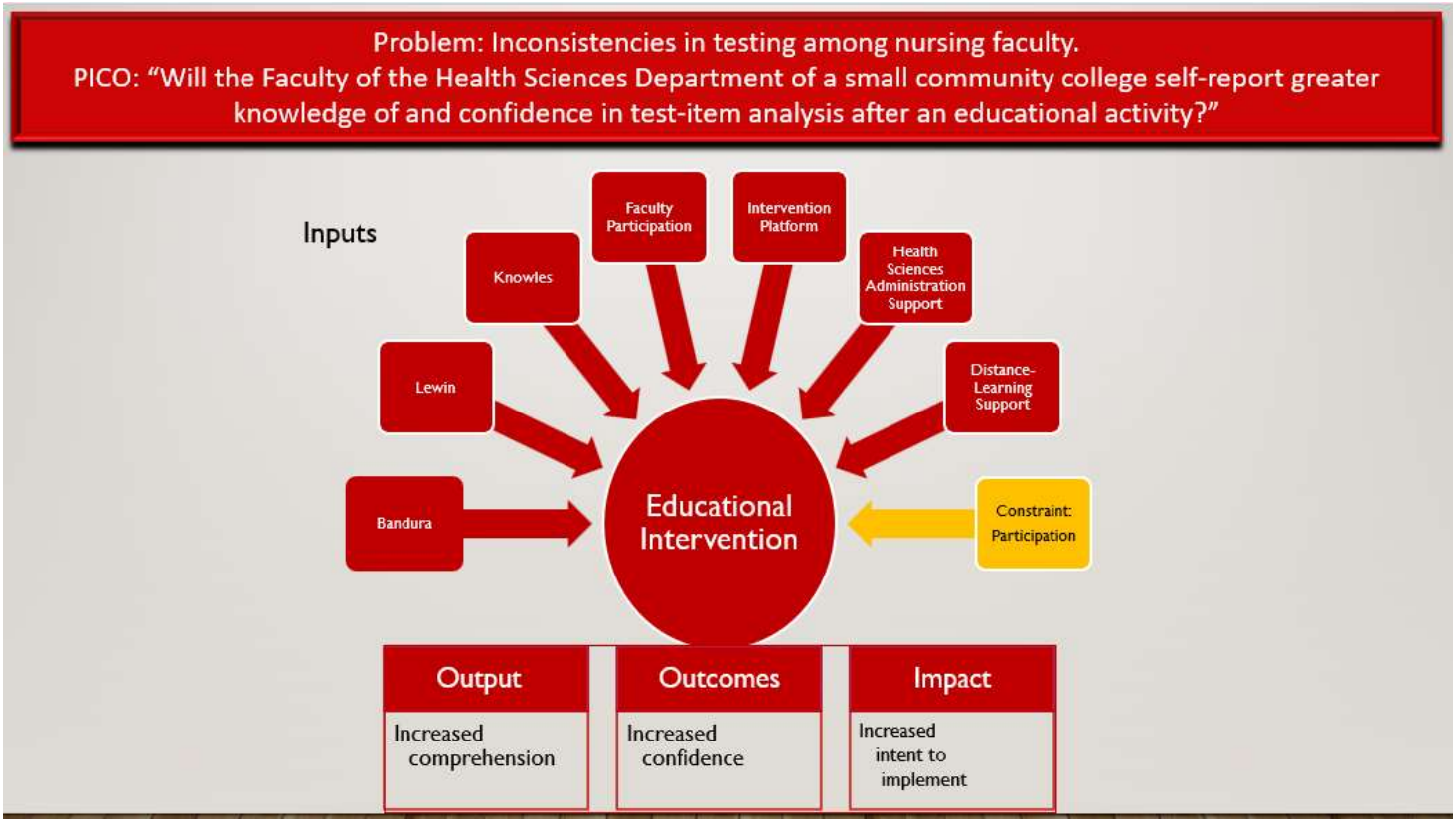
Appendix D

Logic Model



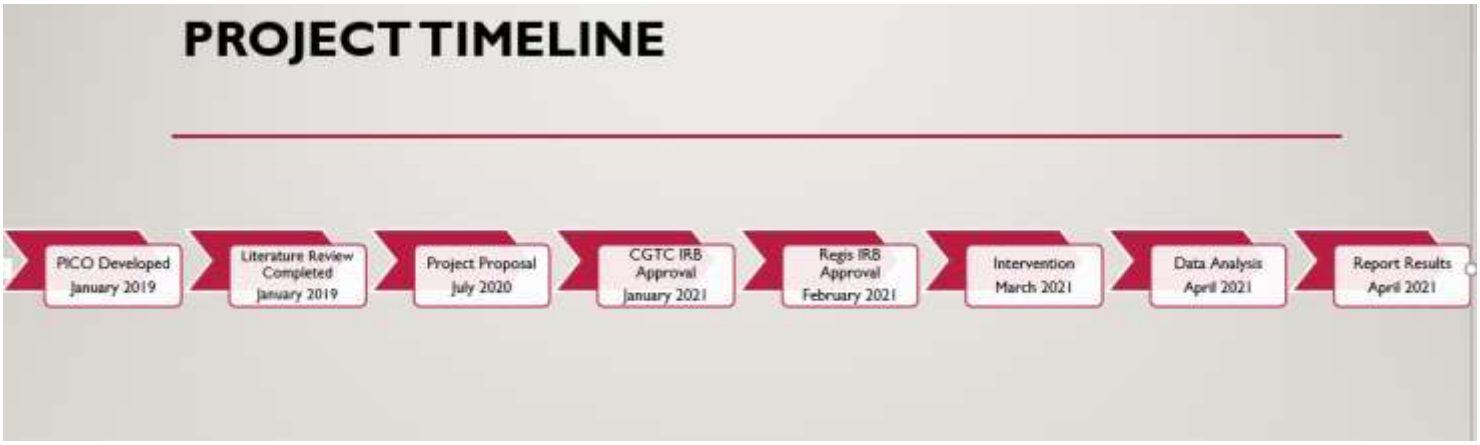
Appendix E

Conceptual Diagram



Appendix F

Project Timeline



Appendix G

Measurement Instruments

Instructions:
Please use the scale below to respond to the following questions regarding your perception of test item-analysis.

Please answer as accurately as possible to reflect your opinions and to answer factual questions to the best of your knowledge.
1=strongly disagree, 2=disagree, 3=neutral, 4=agree 5=strongly agree

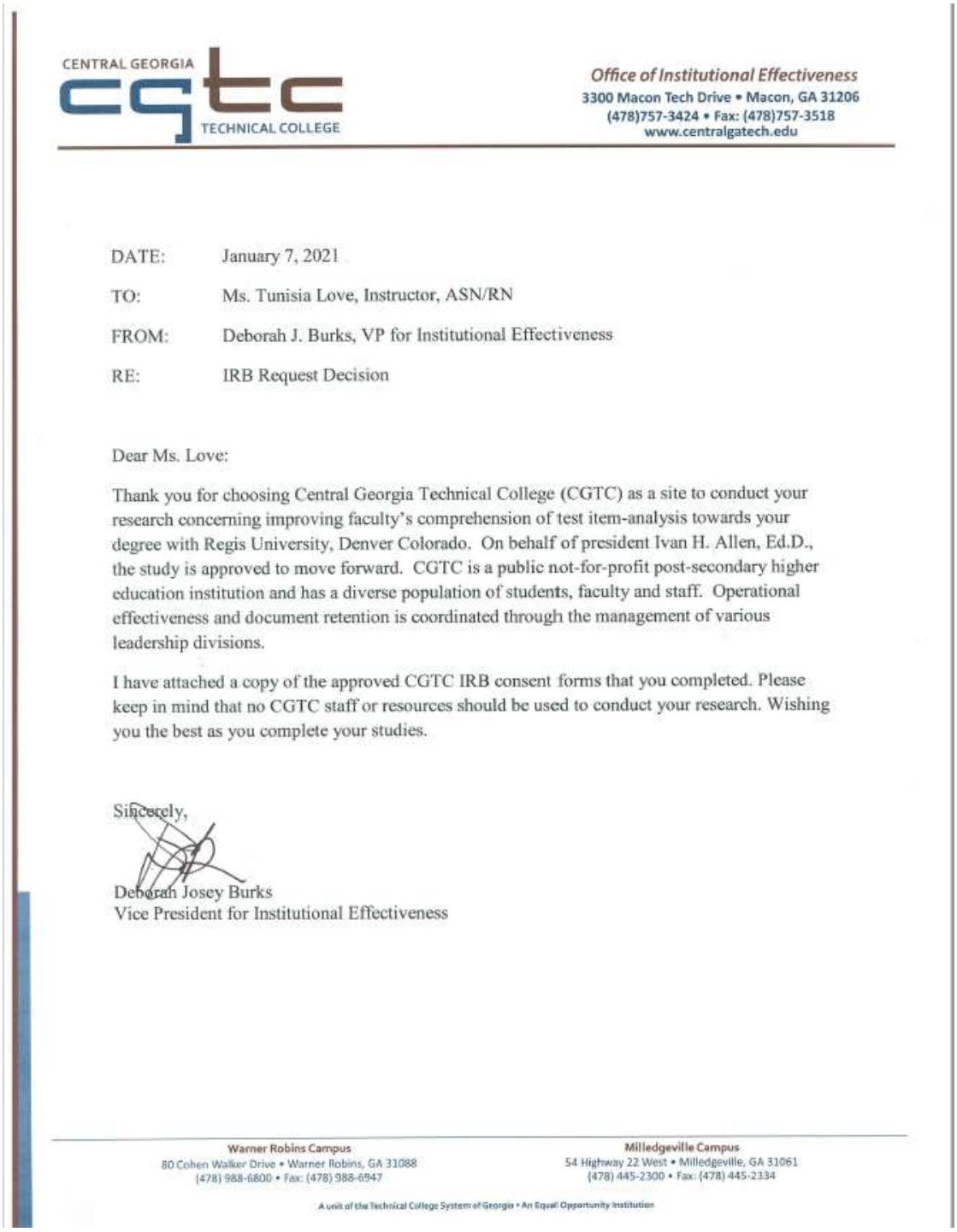
Your information will be kept strictly confidential. To provide anonymity, you will be asked to provide a two-digit code that will be used only to match your pre-test, post-test, and follow-up responses. Please use this code on both the pre-test and the post-test, as well as the follow-up retest. Any survey without a code will not be used for data collection.

Pre-test:
1. Please enter the assigned two-digit code for pre-test to post-test pairing.
2. How many years of teaching experience do you have?
   Select from the following 0-4, 5-9, 10-14, 15-20, >20.
3. To what degree do you comprehend test item-analysis?
4. To what degree do you feel confident in completing test item-analysis?
5. To what degree do you feel you are able to overcome barriers for implementing test item-analysis?
6. Given the following test item result, to the best of your ability, please analyze and rate the item for (1) difficulty, 2) discrimination, and (3) plan for use (total of 3 responses):
A patient is having a thyrotropin-releasing hormone (TRH) stimulation test. After injection of TRH, what response should the healthcare provider expect in a patient with normal thyroid function?

Graded attempts = 54
Key = 92.60%
Discrimination = -0.01
Responses
a. Elevated calcitonin (0.00%)
b. Elevated T3 and T4 (92.6%)
c. Decreased calcitonin (5.56%)
d. Decreased T3 and T4 (1.86%)

Appendix H

Central Georgia Technical College IRB Approval



CENTRAL GEORGIA TECHNICAL COLLEGE

Office of Institutional Effectiveness
3300 Macon Tech Drive • Macon, GA 31206
(478)757-3424 • Fax: (478)757-3518
www.centralgatech.edu

DATE: January 7, 2021

TO: Ms. Tunisia Love, Instructor, ASN/RN

FROM: Deborah J. Burks, VP for Institutional Effectiveness

RE: IRB Request Decision

Dear Ms. Love:

Thank you for choosing Central Georgia Technical College (CGTC) as a site to conduct your research concerning improving faculty's comprehension of test item-analysis towards your degree with Regis University, Denver Colorado. On behalf of president Ivan H. Allen, Ed.D., the study is approved to move forward. CGTC is a public not-for-profit post-secondary higher education institution and has a diverse population of students, faculty and staff. Operational effectiveness and document retention is coordinated through the management of various leadership divisions.

I have attached a copy of the approved CGTC IRB consent forms that you completed. Please keep in mind that no CGTC staff or resources should be used to conduct your research. Wishing you the best as you complete your studies.

Sincerely,

Deborah Josey Burks
Vice President for Institutional Effectiveness

Warner Robins Campus
80 Cohen Walker Drive • Warner Robins, GA 31088
(478) 988-6800 • Fax: (478) 988-6947

Milledgeville Campus
54 Highway 22 West • Milledgeville, GA 31061
(478) 445-2300 • Fax: (478) 445-2334

A unit of the Technical College System of Georgia • An Equal Opportunity Institution

Appendix I

Regis University IRB Approval

REGIS UNIVERSITY

REGIS.EDU

Institutional Review Board

DATE: February 2, 2021

TO: Tunisia Love, DNP
FROM: Regis University Human Subjects IRB

PROJECT TITLE: [1705757-1] Improving Faculty's Comprehension of Test Item Analysis
SUBMISSION TYPE: New Project

ACTION: APPROVED
EFFECTIVE DATE: February 2, 2021
REVIEW TYPE: Limited Review

Thank you for your submission of New Project materials for this project. The Regis University Human Subjects IRB has APPROVED your submission as an Limited Review based on applicable federal regulations. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

The project may proceed as written.

If you need to make any changes to your study, or need to submit a Closure Report marking the end of the study, you may use instructions available by clicking on the "Forms and Templates" button in IRBNet and following the "IRBNet Instructions: Subsequent Packages (Versions)" download. Students may also contact their Faculty Advisor and anybody can reach out to irb@regis.edu for assistance.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation using the appropriate revision forms for this procedure.

Unanticipated problems, serious and unexpected adverse events, and non-compliance issues or complaints must be promptly reported to irb@regis.edu and contacting the IRB Chair and/or Vice-Chair.

This project has been determined to be a project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of .

Please note that all research records must be retained for a minimum of three years after the completion of the project.

If you have any questions, please contact the Institutional Review Board at irb@regis.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Regis University Human Subjects IRB's records.

- 1 -

Appendix J

CITI Training Certificate

CITI PROGRAM

Completion Date 17-Feb-2019
Expiration Date 16-Feb-2022
Record ID 30565238

This is to certify that:

Tunisia Love

Has completed the following CITI Program course:

Not valid for renewal of certification through CME. Do not use for TransCelerate mutual recognition (see Completion Report).

Human Research (Curriculum Group)
Social Behavioral Research Investigators (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

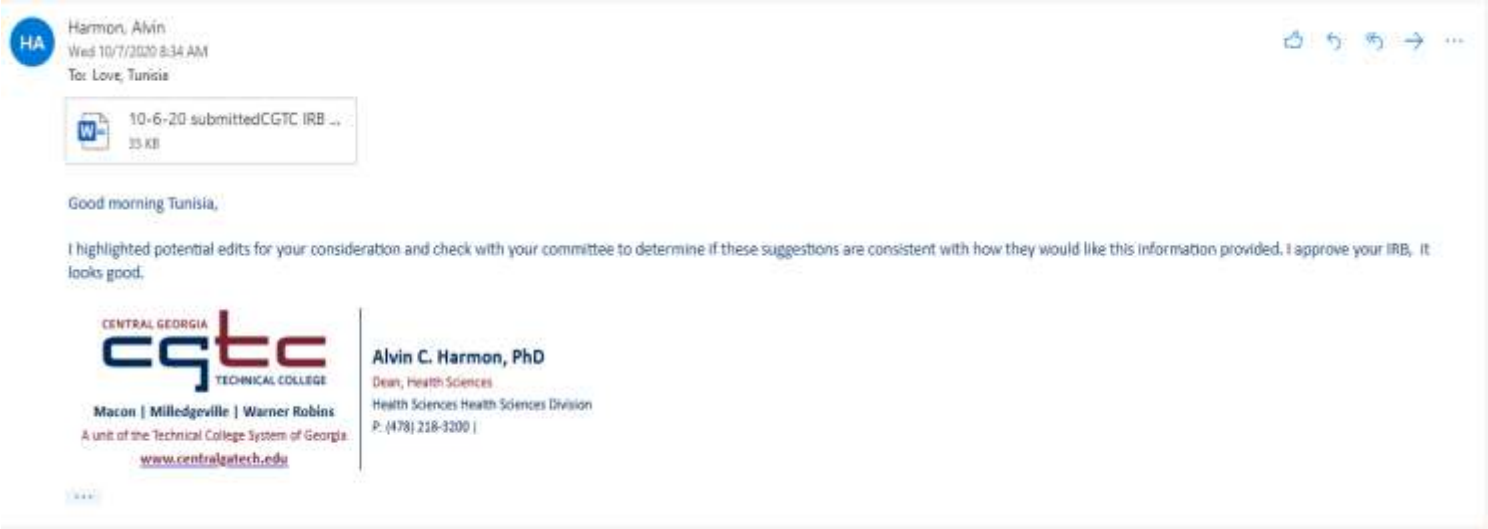
Regis University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wa37801db-1cc2-4da3-8e62-c095079e0b85-30565238

Appendix K

Agency Letter of Support



Harmon, Alvin
Wed 10/7/2020 8:34 AM
To: Love, Tunisia

10-6-20 submittedCGTC IRB ...
35 KB

Good morning Tunisia,

I highlighted potential edits for your consideration and check with your committee to determine if these suggestions are consistent with how they would like this information provided. I approve your IRB, it looks good.

CENTRAL GEORGIA TECHNICAL COLLEGE
Macon | Milledgeville | Warner Robins
A unit of the Technical College System of Georgia
www.centralgatech.edu

Alvin C. Harmon, PhD
Dean, Health Sciences
Health Sciences Health Sciences Division
P: (478) 218-3200 |