Development of Critical Thinking Skills in Nursing Students

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Abstract

Critical thinking is an integral part of being a competent nurse. Critical thinking skills are required for safe practice and are mandated aspects of nursing curricula by state education guidelines and accrediting organization. Having sound critical thinking skills is important to protect, improve, and increase the quality of life. Nursing education is challenged to provide students with the resources to develop and practice the critical thinking skills needed by successful students and competent nurses. This project examined the effect of optional adaptive learning platform activities on the mid-term grades of senior level nursing students. Students were given eight weeks to complete optional National Council Licensure Examination (NCLEX) style questions, concept maps and interactive case studies. Students who completed the optional activities demonstrated higher mid-term grades than the students who did not complete optional activities. These findings may indicate the beneficial effect of including adaptive learning platform activities as required assignments in nursing courses.

Keywords: adaptive learning platform, critical thinking, active learning strategies

Development of Critical Thinking Skills in Nursing Students

Critical thinking is an integral part of being a competent nurse. Critical thinking skills are required for safe practice and are mandated aspects of nursing curricula by state education guidelines and accrediting organization. Having sound critical thinking skills is important to protect, improve, and increase the quality of patient care (Cooke et al., 2019; Li et al., 2019). However, researchers have found that a large percentage of nurse graduates do not have the necessary critical thinking skills required to practice as a novice nurse (Garwood et al., 2018; Cooke et al., 2019). Nursing education is challenged to provide students with the resources to develop and practice the critical thinking skills needed by successful students and competent nurses (Walker, 2016; Ward & Morris, 2016; Ozcan & Elkoca, 2019).

Overview

Problem Description

Demonstration of critical thinking skills is an essential student learning outcome in most pre-licensure nursing programs. However, at a small private liberal arts college, students were found to be lacking in sufficient critical thinking skills required to be successful on the National Council Licensure Examination (NCLEX)-style course exams. Poor exam scores particularly in the upper-level nursing courses, have been identified as a cause for attrition, delay of program progression, and delay in on-time graduation.

In addition to the lack of critical thinking skills, lack of test taking skills among the nursing students was also identified as a contributing factor to poor test scores and to the attrition rate. Students in their junior and senior years take several nursing courses and are expected to successfully take exams with higher cognitive level, NCLEX style questions. Each category of

NCLEX questions requires an increasing level of critical thinking skills. Analysis, synthesis and evaluation questions would be considered higher-level NCLEX questions.

Faculty at the college were charged with the task of developing strategies to address the lack of critical thinking skills in test takers. After review of the curriculum content, faculty discovered that students were given a brief introduction to Bloom's taxonomy and NCLEX-style questions in the second semester of their sophomore year. However, the students were not given opportunities to further develop test taking strategies or critical thinking skills necessary to be successful on NCLEX-style exams. Implementation of a meaningful strategy to improve skills and ultimately exam scores was developed.

The problem statement that guided this project was: In senior level nursing students at a private baccalaureate college, does participation in adaptive learning platform activities beyond the required assignments as compared to students who did not participate result in higher mid-term grades at mid-semester of the spring semester of the senior year?

Outcomes were measured by the mid-term grades. All students were given the same exams and received the same lectures and supplemental classroom content. Mid-term grades were measured and compared between the participating or experimental group and the control group or those students who chose not to participate in additional adaptive learning platform activities. The mid-term grade for each student was calculated by using the two exams given during the first eight weeks of the semester. Overall scores of the two exams, as well as an item analysis including Kuder–Richardson coefficient, point biserial correlation and difficult factor were analyzed. The average of the two exams, which equaled the mid-term grade was entered into the online gradebook which was part of the college's learning management system.

Available Knowledge

Problem

Critical thinking is an essential skill of a competent nurse. Critical thinking skills are required for safe practice and are mandated aspects of nursing curricula by state education guidelines and accrediting organizations. The National League for Nursing Commission for Nursing Education Accreditation (NLN CNEA) defines critical thinking in nursing as "applying knowledge and experience to identify patient problems and directing clinical judgments by selecting from alternatives, weighing evidence, using intuition, and by pattern recognition" (NLN CNEA, 2016, p.5). A nurse who thinks critically, utilizes essential cognitive thinking skills and rationale based on evidence to carry out actions that result in desired patient outcomes (NLN CNEA, 2016). Therefore, incorporating critical thinking skills education into nursing program curricula is essential to developing competent nurses.

However, researchers have found that a large percentage of nurse graduates do not have the necessary critical thinking skills required to practice as a novice nurse (Garwood et al., 2018; Cooke et al., 2019). Nursing education is challenged to provide students with the resources to develop and practice the critical thinking skills needed by successful students and competent nurses (Ward & Morris, 2016; Boso et al., 2020).

Nursing students must begin learning critical thinking skills early in a nursing program, and the process of enhancing these skills should be reinforced and threaded throughout the nursing curriculum (Ward & Morris, 2016; Cook et al., 2019; Boso et al.,2020). Educators who develop nursing curricula look to create innovative strategies to maximize critical thinking skills which also have an impact on nursing students' success (Ward & Morris, 2016; Blum, 2018; Boso et al., 2019; Salar et al., 2020).

Researchers agree that there is no one solution or strategy to develop critical thinking skills in undergraduate nursing students (Ornique & McCarthy, 2015; López et al., 2020). Research studies have demonstrated that students must be actively involved in learning to develop critical thinking skills (Ward & Morris, 2016; Blum, 2018; Garwood et al., 2018; Boso et al., 2020).

Active Learning Strategies

A traditional, direct instruction classroom structure, in which an educator lectures for much of the class time, may not adequately engage today's students whose learning penchants are different from those of earlier generations of students (Garwood et al., 2018; Hinkle et al., 2020). As a result, nurse educators must find effective approaches in order to facilitate student learning and the development of critical thinking skills. According to Garwood et al. (2018) and supported by López et al. (2020), the ability to think critically is an essential attribute for today's nurse, and the development of this skill in nursing students requires engaging approaches and techniques.

For nursing students, common strategies used to develop critical thinking skills include: interactive lectures and seminars that describe the concepts, case simulations and concept mapping where they apply information learned in lectures, clinical experiences where they apply the theory and knowledge learned in the classroom to patients, reflective thinking to enhance clinical experiences, and multiple choice test questions written at higher levels of Bloom’s Taxonomy where they apply and synthesize information learned in lecture (Kaddoura et al., 2016; Aein & Aliakbari, 2017; Zhang et al., 2017; López et al., 2020).

Concept maps can be successfully used to teach conceptual thinking, thus increasing students' competence in critical thinking (Kaddoura et al., 2016; Aein & Aliakbari, 2017;

Garwood et al., 2018). Additionally, concept mapping is a useful cognitive tool for enhancing a student's critical thinking by encouraging students to process information deeply for understanding (Ornique & McCarthy, 2015; Kaddoura et al., 2016; Aein & Aliakbari, 2017; Garwood et al., 2018). The use of concept maps can be implemented as an individual or group activity and has been shown to be an important teaching tool for visual learners (Ornique & McCarthy, 2015; Kaddoura et al., 2016; Aein & Aliakbari, 2017; Garwood et al., 2018). The effectiveness of a concept map as a tool to help student organize their knowledge is noted in both the theoretical and clinical settings (Kaddoura et al., 2016; Aein & Aliakbari, 2017; Garwood et al., 2018).

Research studies have reported that students who used concept mapping demonstrated improved critical thinking skills as compared to students who did not use concept mapping as evidenced by post intervention critical thinking scores (Ornique & McCarthy, 2015; Kaddoura et al., 2016; Aein & Aliakbari, 2017; Garwood et al., 2018). When surveyed, students reported a preference for concept mapping as a tool for learning new concepts over traditional methods (Aein & Aliakbari, 2017; Garwood et al., 2018).

Another researched strategy to improve critical thinking skills is the use of the flipped classroom. In a flipped classroom, the instructor uses interactive teaching/learning methods with students to engage them with subject matter learned prior to class. Flipped classroom learning is more flexible and dynamic than lecture-based classrooms (Dehghanzadeh & Jafaraghaee, 2018;). Students are encouraged to actively engage with classmates and critically think through aspects of the topic presented (Dehghanzadeh & Jafaraghaee, 2018).

In research conducted by Dehghanzadeh & Jafaraghaee (2018) and Salar et al. (2020), students who were assigned to a flipped classroom or were part of learning based on

participatory education demonstrated improved critical thinking skills as compared with students who were assigned to traditional lecture classrooms. Movement away from the traditional lecture classroom to a more interactive one, such as the flipped classroom or participatory education fosters not only critical thinking, but also teamwork and an increase in student satisfaction and motivation (Dehghanzadeh & Jafaraghaee, 2018; Salar et al., 2020).

A popular strategy to teach critical thinking skills in nursing education is simulation. Both live and virtual simulation can be implemented to improve critical thinking skills and clinical outcomes. Shin et al. (2015) studied the effects of multiple simulation exposures on critical thinking skills. After exposure to simulation, the students demonstrated improvement in critical thinking skills. (Shin et al., 2015). Students also demonstrated an increase in "intellectual eagerness" which is one predictor of clinical competency (Shin et al., 2015). Simulation engagement is an important strategy to improve critical thinking skills in nursing students when face-to-face interaction is not possible.

Heiney et al. (2019) studied the use of multi-media case studies as a strategy to improve critical thinking skills. The multi-media approach exposed students to a variety of sources such as video and audio files within a real-life context. After exposure to the multi-media case studies, students' critical thinking skills were significantly enhanced (Heiney et al., 2019).

An emerging strategy to teach critical thinking skills in nursing education is the implementation of the 'Adaptive Learning' (AL) platform. The AL platform encompasses many of the accepted active learning strategies. Such strategies include interactive case studies, concept mapping, virtual case studies, and NCLEX-style adaptive learning questions. The platform is adaptive because it adjusts questions and level of difficulty based on student

responses. This is useful when preparing for the NCLEX. Most adaptive learning platforms are incorporated into the student resources purchased with a text book.

There is a paucity of research that explores the aggregate use of these strategies in an adaptive learning platform. For example, several studies explored the benefits of concept mapping to improve critical thinking skills (Ornique & McCarthy, 2015; Kaddoura et al., 2016; Aein & Aliakbari, 2017). However, few studies have explored the impact of concept mapping and interactive case studies on critical thinking skills. The AL platform offers multiple strategies to improve critical thinking skills and the opportunity to research its effects.

Research conducted by Forsyth et al., (2019) demonstrated the benefits of utilizing AL technology. In their research, the authors described benefits of an AL platform include better student learning outcomes, improved student engagement, and increase in student motivation. Research conducted by Hinkle et al. (2020) confirmed the findings of Forsyth et al. (2019) study. The Hinkle et al. (2020) study reported on research using an AL platform implemented in a nursing pathophysiology course. The authors reported that students in the experimental AL platform group reported that they “learned better” as compared with the control group. Additionally, students in the experimental group reported a higher level of student engagement than their counterparts in the control group (Hinkle et al., 2020).

Rationale

This project was guided an active learning strategy based on the constructivism theory framework. The central idea of constructivism is that student learning is constructed, and that learners build new knowledge upon the foundation of previous learning. According to Anthony (1996), in an active learning environment; the learner is no longer a passive recipient of knowledge. Rather, the learner becomes an active constructor of knowledge (Anthony, 1996).

In an active learning environment, learners develop their existing knowledge and understanding in order to achieve deeper levels of understanding. Anthony (1996) purported that this translates into the learners being better equipped to analyze, evaluate and synthesize ideas, thus achieving the higher order skills of Bloom's Taxonomy.

Dewey (1938), an active learning theorist, suggested that information may be passively received. However, understanding cannot be passive, as it must come from making meaningful connections between prior knowledge, new knowledge, and the processes involved in learning. Learning is a social activity, and it is something that is experienced together, in interaction with each other, rather than an abstract concept (Dewey, 1938).

Constructivist learning theory supports a variety of student-centered teaching methods and techniques which is in contrast with traditional education, whereby knowledge is simply passively transmitted by teachers to students (Dewey, 1938; Anthony, 1996). The primary responsibility of the teacher is to create a collaborative problem-solving environment where students become active participants in their own learning (Anthony, 1996).

The intervention in the proposed study was implementation of an integrated adaptive learning system platform. Students, collaborating with class members completed activities in a safe, yet meaningful way. An integrated learning system included several active learning strategies supported by research (Kaddoura et al., 2016; Ward & Morris, 2016; Garwood et al., 2018; Li et al., 2019). Such strategies included: virtual simulation with discussion questions; interactive case studies, concept mapping, and adaptive National Council Licensure Examination (NCLEX) style questions.

Research supports the use of these active learning strategies to improve critical thinking skills in nursing students (Orique & McCarthy, 2015; Shin et al., 2015; Swart, 2017; Li et al.,

2019; López et al., 2020). In separate studies, researchers demonstrated increased critical thinking skills in students who were exposed to multiple strategies as opposed to control groups who were exposed to only one strategy (Orique & McCarthy, 2015; López et al., 2020). Therefore, the integrated adaptive learning platform affords the student exposure to multiple methods to improve critical thinking.

Purpose

The purpose of this project was to determine if students who utilized an adaptative learning platform beyond the required assignments had higher mid-term grades as compared with students who completed only the required assignment.

Methods

Context

The setting for the project was a private four-year liberal arts college in the Northeastern United States. According to the college website, the college was founded by a religious order and offers over fifty undergraduate programs leading to a Bachelor of Science or a Bachelor of Arts. Nursing and teacher education are the two most common majors. The college offers three master's degree programs in Nursing, Education and Business.

The college is chartered, empowered to grant degrees and registered with the State Department of Education. The college website documents accreditation by the Commission on Higher Education of the Middle States Association and the Commission on Collegiate Nursing Education.

The School of Nursing (SoN) consists of eighteen full time faculty members; all are tenure track positions. There are over seventy adjunct faculty members with a primary focus on the clinical setting. Nursing faculty enjoy shared governance within the SoN.

Admission into the nursing program occurs after the Freshman year with successful completion of science courses with a grade of C or higher. Students must have a cumulative GPA of 2.9 or higher, and there is no admission exam.

The college has over 500 undergraduate and graduate students enrolled in the nursing program. In the undergraduate program, there is a traditional and non-traditional accelerated track. The traditional undergraduate senior class for the 2020-2021 academic year began with a total of 125 students. One hundred and four of the students progressed to the spring semester. These students were participants in the Capstone project.

As noted previously, the need for an intervention was identified by the faculty and administration of the SoN. As a result, they supported the implementation of the Capstone project. This project aligned with the identified goal of the SoN to improve critical thinking skills in nursing students. The Dean of the SoN consented to the implementation of this project.

Intervention(s)

The intervention for the Capstone project was the use of an 'Adaptive Learning' platform (AL). Participants were 104 senior level nursing students enrolled in their last clinical nursing course. The course was team taught by the investigator and another faculty member. The investigator was the course coordinator which necessitated release time for clinical placement of over one hundred students.

Text book resources for the course included a critical care and medical surgical book. The AL platform was part of the required purchase for the medical-surgical text book; however, students did not use the AL platform in previous courses.

The specific AL platform used was Sherpath by Evolve/Elsevier publishing. Sherpath is an AL platform that utilizes many of the strategies to promote critical thinking previously

identified in the literature (Kaddoura et al., 2016; Ward & Morris, 2016; Garwood et al., 2018; Heiney et al., 2019). The platform included the use of concept mapping, interactive case studies, virtual simulations, higher-level NCLEX-style questions, interactive tutorials, and care plans. Various exercises addressed diverse learning styles.

Since the first day of the semester was delayed, the investigator and faculty member met with the students via Zoom platform in January of 2021. The faculty members teaching the course reviewed the syllabus with the class two weeks before the course began. Upon discussion of the AL platform, the investigator recused herself. The remaining faculty member discussed the use of the AL platform, the required assignments, the grade distribution and optional use of the platform.

Students were given an opportunity to participate in a refresher webinar detailing the navigation of Sherpath. This webinar, offered by the publisher was available two weeks prior to the beginning of the spring semester. Faculty members typically have unlimited access to the AL platform. However, for the purposes of the Capstone intervention, the investigator was not given access to the platform.

The AL required assignment for all students in the course was to complete one concept map and one interactive case study for a specific topic covered in class. The grade earned from this assignment was five-percent of the total course grade. Students completed the required assignment by week five.

There were two exams which were scheduled at or before mid-semester break (week eight). One exam was given in week four and the second exam was given during week eight. The average of the two exams equaled the mid-term grade.

Additional use of the adaptive platform was the intervention. Participants self-selected to be part of the intervention. Additional use was voluntary and optional and was not evaluated as part of the course mid-term or final grade. Participants in the course had the opportunity to utilize all of the strategies and exercises in the AL platform. However, the data from the completion of NCLEX-style questions, concept maps, and interactive case studies were analyzed as part of the intervention.

The AL platform concept map was available for each content area taught in the course. Participants had access to the concept map template with prompting questions for assessment data, prioritization of care and treatment plan. The participants were able to electronically save the concept map and upload it to the course site on Sherpath. Once the participant uploaded the concept map, the faculty member, not the investigator, had the ability to evaluate the map for accuracy as well as total time spent on the exercise. Sherpath provided an answer key for the concept map for use by the faculty. The investigator did not correct any assignment and did not pull the data.

Participants had the option to complete up to thirty NCLEX-style questions for each chapter. Once completed, the participant was able to view the correct answers with rationale. The faculty member had the ability to view the total number of questions answered as well as the number correct and time spent on each question. The faculty member was also be able to view areas of participant weakness and mastery of content. Mastery was determined by the difficulty level of the question.

Interactive case studies were also available for participants. Those selecting this exercise were able to choose from over twenty different interactive case studies. Each study included an assessment of a patient, interpretation of lab and diagnostic results, decision point actions, and

documentation on an electronic health record. Each decision had a potential positive or negative patient outcome. After completion, results were electronically saved to the instructor's portal. Each decision, interpretation, and documentation completed by the participant was available for review by the faculty member.

Each week, the faculty member, not the investigator, monitored the use of the AL platform and the specific types of strategies used by the participants. The AL platform was available for the entire semester; however, the faculty member gathered results and pull data through week eight.

Study of the Intervention(s)

The impact of the intervention and the observed outcome was assessed by reviewing the mid-term grades. All exam grades for the course, up to and including the mid-term grades, were calculated and entered by the faculty member, not by the investigator. The faculty member entered the two exam grades into the e-class/Moodle grade book. Additionally, the faculty member pulled the grades for the required AL assignment and entered the grades into the e-class/Moodle grade book. However, the mid-term grade included only the average of the exam grades. The required AL assignment will be calculated into the final grade at the end of the semester.

For the purpose of the intervention, each student in the course was assigned a random number-code by the faculty member, not the investigator. Two excel spread sheets were used to compare the exam grades of the students who used the AL platform beyond the required assignment, the experimental group, with the grades of the students who completed only the required assignment, the control group. The investigator developed the spread sheets and included separate entries for use of NCLEX-style questions, concept mapping and interactive

case-studies. The faculty member, not the investigator pulled the additional data from the Sherpath instructor grade book, looking for the completion of the exercise, not the grade. Additionally, the faculty member documented on the excel spread sheet the number of concept maps, NCLEX-style questions and/or interactive case studies completed by each participant during the eight-week period. The faculty member entered the data into the spread sheet without participant names, and only by number-code.

Subsequent to the completion of the excel spread sheets, the faculty member shared the data with the investigator. The investigator was not aware of the association between the participant's name and the number-code. The investigator evaluated the spread sheet data for correlations between the exam grade average at mid-term and the use of the AL platform strategies beyond the required assignment.

Measures

The primary method of studying the outcome of the intervention was the use of two exams. The exams were developed by the investigator and were first administered to students in the spring, 2020 semester. At that time, the analysis for exam one demonstrated internal consistency reliability as measured by the Kuder-Richardson (KR-20) coefficient. The KR-20 value for exam one was 0.61. A teacher-made assessment should demonstrate reliability coefficients of approximately 0.50 to 0.60 (Quaigrain & Arhin, 2017).

Exam two was also used to measure the outcome of the intervention. Similar to exam one, exam two was constructed by the investigator and previously administered in the spring 2020 semester. Internal consistency reliability demonstrated by the KR-20 coefficient and was measured reported as 0.67.

For the purpose of the capstone study, two Excel spread sheets were used to track data collected by the faculty member. The faculty member, not the investigator, assigned each student a random code. The random code was then entered into either the control or experimental group excel spread sheet. When pulling data from the adaptive learning platform grade book, the use of concept maps, NCLEX-style questions, and interactive case studies were documented on the spread sheet by the faculty member. The investigator chose these three strategies to be in alignment with the outcomes in the available literature (Kaddoura et al., 2016; Garwood et al., 2018; Heiney et al., 2019).

The faculty member entered data regarding the type of exercise/strategy used as well as the number of times each exercise/strategy was used. Documentation of NCLEX-style questions included use of this strategy as well as the number of questions answered. The data from the spread sheets were used to measure the outcome of the intervention in conjunction with the average of the results of exams one and two.

Analysis

A total of 104 students were in the senior nursing class at the beginning of the spring semester. Sixty-three students self- selected to be in the experimental group or group one and completed AL platform activities beyond the required one assignment. Forty-one students completed only the required assignment.

Descriptive statistics were reported on exam one given at week four for the experimental group (M = 86.57, SD = 6.98) and (M = 82.59, SD = 7.41) for the control group. The descriptive statistics were reported for exam two, given at week eight for the experimental group (M = 86.79, SD = 6.72) and (M = 83.32, SD = 7.51) for the control group.

Mid-term grades were entered on an excel spread sheet by the faculty member, not the investigator. An independent-samples one-tail t-test was conducted in Excel to compare the mid-term grades of students who completed the optional AL platform activities beyond the requirement with students who completed only the required assignment (Table 1).

Analysis of the data in Table 1 demonstrated that students who completed adaptive learning platform activities beyond the required assignment had higher mid-term grades (M = 86.68, SD = 5.43) than those who completed only the required one assignment (M = 82.78, SD= 5.81), $t(82) = 3.44$, $p < .001$. Therefore, the data analysis supported the outcome of the study and the use of AL platform strategies to improve test grades.

Ethical Considerations

Upon completion of the written capstone proposal, the investigator obtained approval to submit the proposal to the Nebraska Methodist College Institutional Review Board (IRB). The investigator and faculty mentor completed the required Collaborative Institutional Training Initiative (CITI) program. The project was approved for implementation by the IRB in December, 2020.

Participation in the intervention was voluntary, and participants self-selected. To protect the identity of the students, the faculty member, not the investigator randomly assigned participants a non-identifying numerical code. The data was not traceable to the participants. All data was gathered and entered by the faculty member, not the investigator.

The anonymity of the data also mitigated a potential conflict of interest between the investigator and the participants.

To protect the integrity of the data, all coded data, including survey results were stored on the investigator's password protected computer. The data pulled by the faculty member were

stored on her AL platform portal page which is password protected. The investigator did not have access to this access to this portal.

Results

Senior level nursing students were given two separate unit exams during the eight-week implementation period. When calculating the mid-term grade, the investigator analyzed the same exams given in the spring, 2020 semester. For spring, 2021, the KR-20 noted for exam one and exam two was 0.62 and 0.65 respectively. Since both exams continued to demonstrate internal consistency reliability, the average of both exams was used to determine the outcome and if the students who used additional AL platform strategies had higher grades than those students who completed only the required AL platform activities.

An independent-samples one-tail t-test was conducted to compare the mid-term grades of students who completed optional, additional AL platform activities beyond the required assignment to those students who completed only the required assignment. There was a significant difference in the grades of the students who completed additional activities (M = 86.68, SD = 5.43) compared to than those who completed only the required one assignment (M = 82.78, SD= 5.81), $t(82) = 3.44$, $p = .0005$ (Table 1).

Table 1
t-Test: Two-Sample Assuming Unequal Variances

Mid Term Grades	*Experimental Group*	*Control Group*
M	86.68	82.78
Variance	29.48	33.63
Observations	63	41
Hypothesized Mean Difference	0	
df	82	
t Stat	3.44	
P(T<=t) one-tail	0.00046	

t Critical one-tail	1.66
P(*T*<=*t*) two-tail	0.00092
t Critical two-tail	1.99

*significance level 0.05

These results suggest that additional use of the AL platform activities had a statistically significant effect on mid-term grade compared to those who did not complete the additional activities. Specifically, the results suggest that additional use of the AL platform increased the mid-term grade and confirms that the outcome of higher mid-term grades was met.

Discussion

Summary

The findings of the study support the use of active learning strategies. The three types of activities used in the study as part of the AL platform were considered examples of active learning. Furthermore, the findings demonstrate that combined active learning strategies contributed to higher mid-term grades as compared with students who did not engage in optional active learning strategies (Table 1). All of the students who completed additional activities completed at least one of each type of active learning strategy. This supports the rationale for inclusion of an AL platform which affords the students an opportunity to be exposed to more than one active learning strategy.

The number of participants at 104 in total was a strength of the study. Over half of the class self-selected into the experimental group. In addition, the exams administered demonstrated internal consistency reliability when given to a total of over 200 students in a two-year period.

Lastly, all students were taught by the same faculty members during the eight-week period of time which ensured consistency of material taught.

Interpretation

The findings of this Capstone project were consistent with previous research studies. The results of the Capstone project demonstrated a statistically significant difference in mid-term grades between the students who completed AL platform activities beyond the requirement to those who did not. Research conducted by Forsyth et al., (2019) demonstrated the benefits of utilizing AL technology. In their research, the authors described benefits of an AL platform include better student learning outcomes, improved student engagement, and increase in student motivation. Research conducted by Hinkle et al. (2020) confirmed the findings of Forsyth et al. (2019) study. The authors reported that students in the experimental AL platform group reported that they learned better as compared with the control group (Hinkle et al., 2020).

The Capstone findings also support the previous research which demonstrated that the use of active learning strategies improves critical thinking skills, nursing course grades and/or outcomes (Orique & McCarthy, 2015; Shin et al., 2015; López et al., 2020).

The findings of the Capstone project may have a direct impact on curriculum development and methods of instruction. As faculty seek to engage students in an active exchange of knowledge, the use of components of the AL platform would be consistent with methods of active learning.

Limitations

There are several limitations that should be considered when interpreting the results of this Capstone project. The Capstone project examined senior nursing students at a private college in a critical care nursing course. The course content was very specific and a sub-specialty of

nursing. Many schools of nursing do not have a specific critical care course. Additionally, senior nursing students had more experience with NCLEX-style questions than sophomore or junior students. The implementation took place over an eight-week period, not the entire semester. Therefore, the results therefore might not be completely generalizable.

Conclusions

The revised standards for quality improvement reporting excellence (SQUIRE 2.0) were used as a framework for reporting this project. This project examined the problem of lack of critical thinking skills in senior level nursing students at a private four-year college. The use of an AL platform incorporated many of the accepted strategies to improve critical thinking skills and exam scores. Mid-term grades were analyzed to determine if the use of additional AL strategies resulted in higher grades as compared with those students who completed only the required AL assignments. A statistically significant difference in mid-term grades was found between the students who completed additional activities as compared to those students who did not.

Findings may shape requirements for each nursing course in the nursing curriculum. Use of AL platform or specific components of the platform may be incorporated into learning strategies for each nursing course. Future projects might explore the implementation of adaptive learning platforms in the sophomore year when nursing students take their first nursing course. Early implementation would expose the students to strategies to develop critical thinking skills throughout the curriculum. Further research may explore the use of an AL platform throughout an entire semester and include a survey to determine if students perceived an improvement in critical thinking skills.

With improved critical thinking skills as a result of AL assignments, improvement in test scores may be noted. As a result, overall SoN attrition would decrease. This in turn would lead to appropriate course progression and improve on-time graduation rates. These metrics would be advantageous to the college when marketing and recruiting students for the nursing program. This in turn may lead to an increase in enrollment which would be financially beneficial to the college.

References

Aein, F. & Aliakbari, F. (2017). Effectiveness of concept mapping and traditional linear nursing care plans on critical thinking skills in clinical pediatric nursing course. *Journal of education and health promotion*, *6*(4), 1-6. https://doi.org/10.4103/jehp.jehp_49_14

Anthony, G. (1996). Active learning in a constructivist framework. *Educational Studies in Mathematics, 31*(4), 349-369. https://doi.org/10.1007/BF00369153

Blum, C. A. (2018). Does podcast use enhance critical thinking in nursing education? *Nursing Education Perspectives, 39*(2), 91-93. https://doi.org/10.1097/01.NEP.0000000000000239

Boso, C. M., Merwe, A. S., & Gross, J. (2020). Critical thinking skills of nursing students: Observations of classroom instructional activities. *Nursing Open, 7*(2), 581-588. https://doi.org/10.1002/nop2.426

Cooke, L., Stroup, C., & Harrington, C. (2019). Operationalizing the concept of critical thinking for student learning outcome development. *Journal of Nursing Education, 58*(4), 214-220. https://doi.org/10.3928/01484834-20190321-05

Dehghanzadeh, S. & Jafaraghaee, F. (2018). Comparing the effects of traditional lecture and flipped classroom on nursing students' critical thinking disposition: A quasi-experimental study. *Nurse education today, 71*(12), 151–156. https://doi.org/10.1016/j.nedt.2018.09.027

Dewey, J. (1938) *Experience and Education*. New York: Collier Books.

Forsyth, B., Kimble, C., Birch, J., Deel, G., & Brauer, T. (2019). Maximizing the adaptive learning technology experience. *Journal of Higher Education Theory and*

Practice, 16(4), 80-89. https://www.articlegateway.com/index.php/JHETP/article/view/1992

Garwood, J. K., Ahmed, A. H., & Mc Comb, S. A. (2018). The effect of concept maps on undergraduate nursing students' critical thinking. *Nursing education perspectives, 39*(4), 208–214. https://doi.org/10.1097/01.NEP.0000000000000307

Heiney, S. P., Polyakova-Norwood, V., & DeGregory, C. (2019). Using a continuing multimedia case study to develop critical thinking and empathy. *Journal of Nursing Education, 58*(3), 169-172. https://doi.org/10.3928/01484834-20190221-08

Hinkle, J. F., Jones, C. A., & Saccomano, S. (2020). Pilot of an adaptive learning platform in a graduate nursing education pathophysiology course. *Journal of Nursing Education, 59*(6), 327-330. https://doi.org/10.3928/01484834-20200520-05

Kaddoura, M., Van-Dyke, O., & Yang, Q. (2016). Impact of a concept map teaching approach on nursing students' critical thinking skills. *Nursing and Health Sciences, 18*(3), 350-354. https://doi.org/10.1111/nhs.12277

Li, S., Ye, X., & Chen, W. (2019). Practice and effectiveness of "nursing case-based learning" course on nursing student's critical thinking ability: A comparative study. *Nurse Education in Practice, 36*, 91-96. https://doi.org/10.1016/j.nepr.2019.03.007

López, M., Jiménez, J. M., Martín-Gil, B., Fernández-Castro, M., Cao, M. J., Frutos, M., & Castro, M. J. (2020). The impact of an educational intervention on nursing students' critical thinking skills: A quasi-experimental study. *Nurse Education Today*, *85*(2), 104-114. https://doi.org/10.1016/j.nedt.2019.104305

National League for Nursing Commission for Nursing Education Accreditation (2016). *Accreditation standards for nursing education programs*.

http://www.nln.org/docs/default-source/accreditation-services/cnea-standards-final-february-201613f2bf5c78366c709642ff00005f0421.pdf?sfvrsn=12

Orique, S. B. & McCarthy, M. A. (2015). Critical thinking and the use of nontraditional instructional methodologies. *Journal of Nursing Education, 54*(8), 455-459. https://doi.org/10.3928/01484834-20150717-06

Ozcan, H. & Elkoca, A. (2019). Critical thinking skills of nursing candidates. *International Journal of Caring Sciences, 12*(3), 1600-1606.

Quaigrain, K. & Arhin, A.K. (2017). Using reliability and item analysis to evaluate a teacher-developed test in educational measurement and evaluation. *Cogent Education, 4*(1), 1-12. https://doi.org/10.1080/2331186X.2017.1301013

Salar, A., Fouladi, B., & Sarabandi, A. (2020). Comparing the effect of "learning based on classic education" and "learning based on participatory education" on nursing students critical thinking: A case–control study. *Journal of Education and Health Promotion, 9*(1), 47. https://doi.org/10.4103/jehp.jehp_257_19

Shin, H., Ma, H., Park, J. & Eun, S. (2015). The effect of simulation courseware on critical thinking in undergraduate nursing students: Multi-site pre-posttest study. *Nurse Education Today, 35*(4), 537-542. DOI: 10.1016/j.nedt.2014.12.004

Swart, R. (2017). Critical thinking instruction and technology enhanced learning from the student perspective: A mixed methods research study. *Nurse Education in Practice, 23*, 30-39. https://doi.org/10.1016/j.nepr.2017.02.003

Walker, L. P. (2016). A bridge to success: A nursing student success strategies improvement course. *Journal of Nursing Education, 55*(8), 450-453. https://doi.org/10.3928/01484834-20160715-05

Ward, T. D. & Morris, T. (2016). Think like a nurse: A critical thinking initiative. *ABNF Journal, 27*(3), 64-66.

Zhang, C., Fan, H., Xia, J., Guo, H., Jiang, X., & Yan, Y. (2017). The effects of reflective training on the disposition of critical thinking for nursing students in China: A controlled trial. *Asian Nursing Research, 11*(3), 194-200. https://doi.org/10.1016/j.anr.2017.07.002