Modeling Evidence-Based Application: Using Team-Based Learning to Increase Higher Order Thinking in Nursing Research

Bridget MOORE
College of Nursing, University of South
Alabama Mobile, Alabama 36688, USA

and

Jennifer STYRON
College of Nursing, University of South
Alabama Mobile, Alabama 36688, USA
and

Kristina MILLER
College of Nursing, University of South
Alabama Mobile, Alabama 36688, USA

ABSTRACT

Nursing practice is comprised of knowledge, theory, and research [1]. Because of its impact on the profession, the appraisal of research evidence is critically important. Future nursing professionals must be introduced to the purpose and utility of nursing research, as early exposure provides an opportunity to embed evidence-based practice (EBP) into clinical experiences. The AACN requires baccalaureate education to include an understanding of the research process to integrate reliable evidence to inform practice and enhance clinical judgments [1]. Although the importance of these knowledge competencies are evident to healthcare administrators and nursing leaders within the field, undergraduate students at the institution under study sometimes have difficulty understanding the relevance of nursing research to the baccalaureate prepared nurse, and struggle to grasp advanced concepts of qualitative and quantitative research design and methodologies.

As undergraduate nursing students generally have not demonstrated an understanding of the relationship between theoretical concepts found within the undergraduate nursing curriculum and the practical application of these concepts in the clinical setting, the research team decided to adopt an effective pedagogical active learning strategy, team-based learning (TBL). Team-based learning shifts the traditional course design to focus on higher thinking skills to integrate desired knowledge [2]. The purpose of this paper is to discuss the impact of course design with the integration of TBL in an undergraduate nursing research course on increasing higher order thinking.

Keywords: Nursing, evidence-based practice, EBP, team-based learning, TBL, nursing practice, nursing research, education.

1. INTRODUCTION

The profession of nursing continues to evolve over time as a result of numerous reforms and modernizations in the field, which include novel approaches to patient care, pharmaceutical developments, and emerging technologies. The dissemination of contributions to the field through research publications and professional conferences therefore is critical to ensure that innovative strategies can be replicated and shared across international and national healthcare systems. Research is an integral component in the transformation of healthcare, promoting advancement in clinical practice with an emphasis of enhancing patient safety and the quality of patient care.

As undergraduate nurses prepare for transition into their practice role, the ability to integrate research evidence to the bedside is crucial. Knowing how to access appropriate findings, assimilate the information, and translate it to patient care requires an understanding of the process of EBP. Exposure to EBP encourages life-long professional behaviors and increases students' understanding of and motivation to stay current in the field. Additionally, research has indicated that nurses play a critical role in the identification, intervention, assessment, refinement, and correction of healthcare errors [3].

Team-based learning is an educational approach used with student groups to harness the benefits of interactive learning with synergistic benefits of instructor-led content presentation coordination [4]. This research team engaged undergraduate learners through the readiness assurance process. Faculty held students accountable for knowledge acquisition outside of the classroom, as they became active participants in the acquisition of information. As a result, in-class time was dedicated to knowledge transfer through application activities that incorporated course concepts, rather than a mastery of knowledge acquisition. This provided the opportunity for immediate feedback on team reasoning and critical thinking. It also increased the opportunity for students to gain/improve on collaboration and communication skills.

2. METHODOLOGY

Study Design

This pilot took place in the Fall semester of 2014, at a southeastern university in the United States. Nursing students entering their professional curriculum and enrolled in an undergraduate nursing research course ($N = 92$) participated in the study. The course focused on the research process, methods for critiquing research, and the ethical principles and legal implications of research. The course was taught as a hybrid, requiring students to only attend mandatory days in which TBL activities were utilized, however, classroom activities and lessons were delivered face-to-face weekly during the semester. The students were divided into permanent teams within the course and TBL was integrated to increase students' higher order thinking. The research study specifically focused on critical thinking, collaboration, and communication skills. The purpose of the integration was to increase retention of knowledge and knowledge transfer to practice through team-based application activities. Additionally, a readiness assurance process was utilized to ensure both the preparation of individual students and knowledge acquisition were met before engaging in application activities. Because the traditional didactic model focused primarily on receiving information rather than applying the knowledge gained, units in this EBP course were revised to engage students through TBL pedagogy.

The pedagogy of Team-Based Learning (TBL) was implemented as a pilot study in an undergraduate nursing research course entitled "Evidence-Based Practice in Nursing" during the Fall 2014 semester at a southeastern United States university. The objectives of the course include differentiating the components of the research process; explaining the relationship between nursing research, theory development, and nursing practice; using the research process to critique research; and accessing research resources to determine their applicability to practice. The faculty of this course felt that implementing TBL through the use of individual and team readiness assessment tests (iRATs and tRATs, respectively) and high-level application activities would increase higher order thinking and student understanding of all aspects of the research and evidence-based practice process. The purpose of the integration was to increase retention of knowledge and knowledge transfer to practice through team-based application activities. Additionally, a readiness assurance process was utilized to ensure both the preparation of individual students and knowledge acquisition were met before engaging in application activities. Because the traditional didactic model focused primarily on receiving information rather than applying the knowledge gained, units in this EBP course were revised to engage students through TBL pedagogy.

Nursing students (N = 92) enrolled in an undergraduate nursing research course in the Fall of 2014 participated in the pilot study. The outcomes of the students who participated in the pilot study were compared to the same outcomes of a group of students who took the course using a traditional lecture format in the Fall of 2013 (N = 128). The course was taught as a hybrid, requiring

students to only attend mandatory days in which TBL activities were utilized, however, classroom activities and lessons were delivered face-to-face weekly during the semester. The students were divided into permanent teams within the course, and TBL was integrated to increase students' higher order thinking. The course faculty developed and implemented one iRAT/tRAT and eight high-level application activities.

The research study was presented to the Institutional Review Board and approval was granted. Four research questions were developed to guide the study:

1. Was there a difference between pre- and post- test critical thinking and collaboration scores when utilizing TBL?
2. What were the student perceptions regarding team member effectiveness throughout the course?
3. To what extent did the use of TBL increase passing scores on tests, assignments, and course grades when compared to previous non-TBL courses?
4. To what extent did the use of TBL reduce the number of student course withdrawals when compared to previous non-TBL courses?

Findings

To answer the first research question, every student completed a pre- critical thinking and collaboration survey at the beginning of the semester and a post-critical thinking and collaboration survey at the conclusion of the semester. The survey was entitled "Quality Enhancement Plan Collaborative/Critical Thinking Survey" and consisted of 19 items, in which students responded using a Likert scale format. The post-test survey also included space for narrative feedback. The instrument was developed by our institution's Quality Enhancement Plan director and comprised test items from the National Survey of Student Engagement that focused on the areas of critical thinking and collaboration. Mean scores were analyzed to determine the difference in critical thinking and collaboration. No identifying information was provided on the survey, so students' answers were anonymous.

To answer the second research question, students were asked to complete a Comprehensive Assessment of Team Member Effectiveness (CATME) at mid-term and at the conclusion of the semester. CATME provides students with feedback regarding their work within teams, creating accountability for team-member contributions. This instructional feedback provides students with the ability to improve team skills and increases the likelihood of team learning experiences. Additionally, student course satisfaction was gauged in the team evaluations and used to refine course activities.

To answer research questions three and four, course withdrawals and final course grades from this pilot (Fall 2014) were compared with archived course grades from

a previous semester (Fall 2013) to determine if any differences existed.

3. RESULTS AND DISCUSSION

Quantitative data were entered into the SPSS statistical analysis program. Descriptive statistics and independent-sample *t*-tests were conducted to determine if there were significant differences between critical thinking and collaboration pre- and post- test scores, course grades, and course withdrawals. Qualitative data included open-ended feedback from students on the Comprehensive Assessment of Team Member Effectiveness (CATME) and course evaluations were used to determine student perceptions regarding team member effectiveness and Team-Based Learning.

Descriptive Statistics

The course under investigation is typically offered in the Fall and Summer semesters. Team-Based Learning (TBL) was piloted in the course under study in Fall Semester of 2014. Comparison data was utilized from the prior year (Fall Semester, 2013), which did not utilize TBL. The Fall Semester of 2014 course included 3 sections and had a total of 92 students; the Fall Semester of 2013 course included 4 sections and had a total of 128 students. Students in the TBL course (2014) were administered a pre- and post-test critical thinking and collaboration survey developed by the institution's Quality Enhancement Plan. Both the pre- and post- test included 19 items, utilized with permission from the National Survey of Student Engagement (NSSE). All 19 items were on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). These items focused on critical thinking and communication skills. Post-test scores revealed that students felt collaboration on course activities increased ($M = 4.16$, $SD = 1.08$); collaboration skills improved ($M = 4.37$, $SD = .88$); and their critical thinking and analytical skills increased ($M = 4.06$, $SD = .92$). In addition, students felt they memorized material less ($M = 3.48$, $SD = 1.15$). An interesting finding was that students reported lower mean scores on the post-test with regards to the ability to solve real world problems ($M = 3.48$, $SD = 1.13$). Table 1 provides descriptive information on each of the 19 items.

Table 1

Means and Standards Deviations for Pre-/Post- Critical Thinking and Collaboration Test Items

Item	Pre-Test N = 91		Post-Test N = 90	
	M	SD	M	SD
I ask questions or contribute to course discussion in other ways.	3.54	.97	3.89	.87
I ask other students to help me understand course materials.	4.00	.94	3.93	1.08
I explain course material to other students.	3.85	.83	3.88	.95
I prepare for exams by discussing or working through course materials with other students.	3.32	1.19	3.51	1.18
I work with other students on course projects or assignments.	3.66	1.16	4.16	1.08
I give course presentations in groups (not just PPT presentations).	3.02	1.15	3.12	1.32
I work effectively with other students.	4.36	.77	4.37	.88
I combine ideas from different courses when completing assignments.	4.25	.85	4.00	.95
I connect my learning to societal problems or issues.	3.86	.93	3.71	1.16
I examine the strengths and weaknesses of my views on topics and issues.	3.85	.93	3.81	1.04
I imagine how an issue looks from another's perspective to better understand someone else's view.	4.12	.74	3.96	.90
I connect ideas from courses to my prior experiences and knowledge.	4.27	.83	3.89	.98
I memorize course material.	3.63	1.00	3.48	1.15
I apply facts, theories, or methods to practical problems or new situations.	4.00	.86	3.79	.94
I analyze an idea, experience, or line of reasoning in depth by examining its parts.	3.83	.85	3.82	.99
I evaluate a point of view, decision, or information source.	3.81	.86	3.99	.85
I form new ideas of understandings from various pieces of information.	4.03	.80	3.92	.91
I think critically and analytically.	3.93	.84	4.06	.92
I can solve real-world problems.	4.01	.85	3.48	1.13

The post-test included an additional 10 items soliciting student feedback regarding the use of Team-Based Learning as an instructional strategy. All 10 items were on a Likert scale from 1 (strongly disagree) to 5 (strongly agree). A total of 87 students completed this section. Students felt that solving problems in a team was an effective way to learn ($M = 3.93$, $SD = 1.15$); and that TBL improved their communication ($M = 3.72$, $SD = 1.18$) and collaboration skills ($M = 3.82$, $SD = 1.14$). Additionally, students agreed that they came to class prepared for TBL activities ($M = 4.03$, $SD = .96$). Table 2 provides descriptive information on each of the 19 items.

Table 2

Descriptive Data for the Utilization of Team-Based Learning Items

Item	Min	Max	*M*	*SD*
TBL helped increase my understanding of course material.	1.00	5.00	3.62	1.30
I generally felt prepared for the iRAT (Individual Test).	1.00	5.00	3.55	1.12
There was a connection between readiness assurance tests (iRATs and tRATs) and team activities.	1.00	5.00	3.78	1.11
Solving problems in a team was an effective way to learn.	1.00	5.00	3.93	1.15
tRAT (Team Test) discussion allowed me to correct my mistakes and improve understanding of concepts.	1.00	5.00	3.79	1.16
Team activities had real-world applications.	1.00	5.00	3.64	1.15
TBL helped me improve my critical thinking skills.	1.00	5.00	3.61	1.23
TBL helped me improve my communication skills.	1.00	5.00	3.72	1.18
TBL helped me improve my ability to work with others.	1.00	5.00	3.82	1.14
I came to class prepared.	1.00	5.00	4.03	.96

Research Question One

An independent samples *t*-test was conducted to determine whether or not differences existed between pre- and post- test critical thinking and collaboration scores. A pre- and post- test score were calculated by summing the critical thinking and collaboration items and dividing them by the number of items (19) solicited. Pre-test scores were not significantly different from post-test scores, t (172) = .40, p = .69. Table 3 provides means and standard deviations by test time.

Table 3

Means and Standard Deviations for Test Scores by Time

Time	*N*	*M*	*SD*
Pre	89	3.85	.52
Post	85	3.81	.71

Research Question Two

Both quantitative and qualitative descriptive data were collected using the Comprehensive Assessment of Team Member Effectiveness (CATME) to determine student perceptions regarding team member effectiveness in a team-based learning course. The first section of CATME solicits each student to rate all members of their team in the following five categories: contributing to team's work (C); interacting with teammates (I); keeping the team on track (K); expecting quality (E); and having related knowledge, skills, and attitudes (H). Students in the team-based learning course were required to complete two peer evaluations, one at mid-term and one at the end of the class. The first peer evaluation was not scored, but provided the team and each individual feedback on his/her member effectiveness. This allowed individuals an opportunity to self-identify areas of weakness and improve in these areas prior to the final peer evaluation. In addition, it provided the faculty the opportunity to identify challenges or potential team conflicts. Students were provided descriptive data for each category and asked to select the corresponding level of agreement with the respective team member's contribution in that particular categorical area. Each item's score range was from 1 to 5, with a rating of 5 being the highest score (high level of agreement) and a score of 1 being the lowest score (low level of agreement). Overall, students rated their peers a score of 4 or above in each category, with slight increases in all categories from mid-term to final peer evaluations. Table 4 provides means and standard deviations by test time.

Table 4

Means and Standard Deviations for Team Categorical Ratings

Time		C	I	K	E	H
Midterm	*M*	4.3	4.4	4.3	4.4	4.4
	SD	.82	.74	.80	.77	.79
Final	*M*	4.6	4.6	4.5	4.6	4.6
	SD	.71	.67	.68	.64	.66

The second domain explores individual perceptions of team satisfaction in the following three categories: I am satisfied with my teammates; I am pleased with the way my teammates and I work together; and I am very satisfied working in this team. Each student was asked to select the corresponding level of satisfaction with the three items related to team satisfaction. Each item's score range was from 1 to 5, with a rating of 5 being the highest score (high level of satisfaction) and a score of 1 being the lowest score (low level of satisfaction). An overall team satisfaction mean score was calculated for each team by summing the mean scores for each of the three categories. The overall team satisfaction mean scores indicated that students were satisfied with working in teams and that students' level of satisfaction increased from the midterm evaluation (*M* = 4.50, *SD* = 0.54) to the final evaluation (*M* = 4.57, *SD* = 0.55).

The last section on the CATME peer evaluation was open-ended, giving students a chance to provide additional feedback to faculty. Of the 92 students who completed the CATME peer evaluation, 39% (*N* = 36) contributed to this section. Open-ended responses were analyzed by using a selective coding technique to develop topical categories for each peer evaluation (one for mid-term findings and one for the final findings). To quantify responses, researchers used a nominal ordinal method recording relative to the frequency for each response category [5]. Data was coded to determine if any themes existed, thus providing insight to faculty regarding team-based learning and team member effectiveness.

Mid-term Peer Evaluation: The two most prevalent themes in support of Team-Based Learning (TBL) and team member effectiveness included team collaboration and communication and the effectiveness of TBL as an instructional strategy in helping students meet target mastery levels. Almost all responses indicated that the teams worked well together. Of particular note, is that many students felt that their peers put forth adequate effort, worked sufficiently and cooperatively, and contributed equally. One student indicates the collaborative nature of TBL by stating, "We don't always agree but we are able to talk through our disagreements to come to our conclusion/decision." Another student recognizes the value of working with teams and its impact on student learning by stating, "Not only did I like my group but they also helped me understand things that I wasn't getting from the teacher. This class is probably one of my favorites."

Students recognized and appreciated the diversity of the teams and found they were able to work collaboratively to generate ideas. The second theme, effectiveness of TBL as an instructional strategy indicated that students enjoyed the class and TBL activities. While TBL was not identified as the difference between other types of cooperative learning techniques, students did identify that typically they did not like "group" assignments however were pleasantly surprised, as these teams were "different". One student stated, "I have not been a big fan of group work since I have gotten stuck with some not so great groups but this group is different."

Finally, student feedback indicated they believed the use of TBL was extremely helpful with understanding course materials. One student stated, "This class covers difficult topics to grasp but our team is very helpful explaining concepts to each other." A second student response supporting this finding stated, "Team-based learning is great for this class and really helps with making it fun while we are learning at the same time." In addition, a few responses called for more TBL activities in the course.

The two most prevalent themes discussing challenges of Team-Based Learning (TBL) and team member effectiveness included team communication and classroom space. There were four comments left regarding the need for improvement in communication, with two comments addressing the lack of full participation from all teammates in TBL activities and the second comment identifying frustration from ideas/comments that were ignored by the team. Finally, although only four responses indicated frustration with the classroom layout, anecdotal data from students during class seem to indicate the difficulty to participate in active learning activities in a traditional lecture style classroom. To address this matter, course faculty relocated the class to a classroom built for TBL on campus for the remaining TBL activity days.

Final Peer Evaluation: Three prevalent themes supporting Team-Based Learning (TBL) in the final peer evaluation included team collaboration and communication, self-assessment and improvement, and perceptions of advancements in student learning. Students once again reported feeling a sense of communication and collaboration. Some responses indicated teams had improvement in communication and collaboration over the course of the semester. Overall, students felt the teams were effective, cooperative, and efficient. Additionally, one student responded, "Everyone brought something to the table that made our team successful when performing the assignments that were given to us." Another student stated, "We have recognized each other's strengths and work off of them. We discuss before we give a final answer and everyone has an equal voice… I couldn't be happier."

Another theme indicated that the use of CATME was an effective method in not only assessing team member effectiveness but also in providing the opportunity for students to reflect on their own performance as a team member and make improvements in their team contributions. Developing skill sets to work effectively in a team is also a learning process. Providing a peer evaluation at the midpoint of the semester and releasing feedback to students with regard to their peer evaluation allows students to self-assess and improve their skill sets to be successful in a team. Students also indicated that teammates' performance improved from mid-term to the end of the semester. One student reported, "Using CATME evaluations made teammates more aware of their negative behavior and helped me improve attitudes following the first evaluation."

The final theme identified was that students perceived their learning improved through the use of TBL as an instructional strategy. Student responses indicated that they believed they learned a lot from the class, that using teams improved learning and allowed each team member the ability to teach others, and that working in teams was a useful way to develop social skills. One of the keys to TBL is improving higher order thinking skills by fostering meaningful discussion among team members during TBL activities. Students indicated that team activities provided opportunities for discussion and debate causing the team to consider all options before arriving at a conclusion for the activity. Two student responses support this, with one student stating, "We participated in debate within the group and discussed topics together. Everyone took time to contribute and it was very helpful." Congruence can be seen in a second student's response that stated, "The team I am on listens to every opinion before making a decision. Everyone contributes in the activities and makes class assignments flow with ease."

Only four responses were associated with the challenges of the utilization of TBL, which included grading reliability among course section faculty and curricular scheduling. The student concern with grading reliability was associated with an individual assignment therefore has no relation to the measure of the effectiveness of the utilization of TBL, however, ensuring that course faculty are properly trained and provided sufficient guidance on grading may reduce this challenge. The second concern dealt with curricular scheduling, to include the sequence of this class during a normal nursing student schedule, the hybrid nature of the course, and developing better TBL activities. The challenges related to course schedule and hybrid nature of the course were shared with the department chair and the curricular committee to ensure that student concerns were addressed and TBL activities were refined to improve in-class activities.

Research Question Three
An independent samples *t*-test was conducted to determine whether or not differences existed between final course grades when utilizing Team-Based Learning. Comparison course grades were utilized from a non-TBL course offering, which occurred in the prior Fall Semester of 2013. A statistically significant difference was found in course grades, $t(213) =$

5.88, p = .00, with non-TBL course grades slightly higher (M = 91.68, SD = 3.52) than TBL course grades (M = 88.67, SD = 3.95).

Research Question Four

An independent samples t-test was conducted to determine whether or not differences existed between course withdrawals when utilizing Team-Based Learning. Comparison course withdrawals were utilized from a non-TBL course offering, which occurred in the prior Fall Semester of 2013. No statistically significant difference was found in course withdrawals, t (218) = -.083, p = .93, with non-TBL course withdrawals slightly higher (N = 3) than TBL course grades (N = 2).

4. LIMITATIONS AND RECOMMENDATIONS

Fall of 2014 was the first semester TBL was used in this undergraduate nursing research course. There were opportunities for improvement noted during this first iteration, particularly in some of the application activities. On one of mandatory TBL class days, students were to secure articles and read them before coming to class. It was found during faculty interaction with the teams that some teams spent time in the course allotted for team activities on finding the articles they should have already read. This created lost course time and was unfair to the students who prepared for the activity. Additionally, it prohibited the ability to complete the activity in-class with teams.

To truly demonstrate higher order integration of EBP principles in the student's future practice, it would be of value to follow up with the students after they have practiced for a year. To compare students from the non-TBL (Fall 2013) semester to those from the TBL (Fall 2014) semester could provide insight to true value. This would likely be inefficient, as tracking students could prove difficult. However, the course faculty will continue to assess the effectiveness of TBL and make improvements to the instructional strategy as needed.

5. CONCLUSION

Undergraduate nursing students in a research introductory course participated in a team-based learning course to enhance higher order thinking. It was found by this team of educators that TBL did not significantly affect pre- and post- test critical thinking and collaboration scores. The CATME scores increased slightly from mid-term to the end of the term. The scores at both times suggest students were satisfied with working in teams and perceived to learn more as a result of the instructional strategy, TBL.

The overall class scores were significantly higher in the Fall 2013 non-TBL course compared to the same results of the Fall 2014 cohort. This may be a result of course redesign for TBL which included revisions to course assignments and also the integration of higher order thinking assessments and application activities as opposed to low level skill assessments. Lastly, when considering the drop rate of the two groups of students, there was no statistically significant difference in the number of withdrawals from Fall of 2013 to Fall 2014 although the number of course withdrawals decreased. Both student achievement and withdrawal rates will continue to be monitored to determine if these findings are merely coincidental.

Although the TBL course does not objectively appear to enhance the outcomes of the course, the researchers advocate the continued use of TBL in this course for several more cohorts. The TBL integration in this course is new and may require revision, however, improvements in student attitudes and engagement in a content area previously considered as "dry or difficult to understand" have been noted by the faculty team. In addition, there may be value to using TBL practices with a historically noninteractive course. The purpose of the course is to motivate future nursing professionals to engage in and translate research to practice through the use of evidence-based practice at the bedside. Ingraining knowledge through the use of active learning strategies, such as Team-Based Learning, supports higher order thinking.

6. REFERENCES

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