TECHNOLOGY FACILITATED PBL PEDAGOGY AND ITS IMPACT ON NURSING STUDENT'S ACADEMIC ACHIEVEMENT AND CRITICAL THINKING DISPOSITIONS

Wei-Chieh Wayne YU
Chang Gung University of Science & Technology, Taiwan

Chunfu Charlie LIN
National Formosa University, Taiwan

Mei-Hsin HO
Chang Gung University of Science & Technology, Taiwan

Jenny WANG
National Formosa University, Taiwan
jamiemeetsworld@gmail.com

ABSTRACT
The impact of particular learning environments and self-regulation could be a beneficial area for research focus. More specifically, there has not been sufficient attention given to the role played by disposition or "will" in facilitating self-regulation to be successful. A student can possess the skills or ability to think critically but lack the will or motivation to use those skills. This quasi-experimental study investigated traditional lecture instruction, PBL, and blended problem-based learning (B-PBL) on students' academic achievement and critical thinking dispositions. The results were compared. The findings revealed that the use of a blended problem based learning strategies had a positive impact on student achievement. However, no significance was found among the groups in critical thinking dispositions for categorical variables at both the pretest and posttest, indicating the need for long-term exposure to B-PBL environments before results could reveal significant changes in attitude towards the usage of critical thinking skills. Recommendations included conducting a longitudinal study and a qualitative study, and further studies be conducted within different disciplines and with different class levels regarding different combinations of using ICT and PBL.

Keywords: Technology facilitated learning, PBL Pedagogy, Academic achievement, Critical thinking dispositions

INTRODUCTION
Educators will influence every single individual who goes out into society and pushes her/his way through the trenches of workforce systems. It is imperative for students to graduate from college having the skills to think critically; in addition, they must have high levels of motivation and high levels of willpower in order to practice critical thinking skills. The workforce environment will require those who can critically think through problems, find solutions, and teamwork with diverse people. This requires high self-regulatory processing in order to cope under these inevitable workforce conditions, not just the skills to do so.

PBL works well as a training vehicle for future environmental problem solvers and supports and sustains critical thinking and analysis, effective communication skills, and can promote the development of lifelong learning skills (Duch et al., 2001). It is, in particular, a powerful way to link the content of higher-education courses to the world outside the academic environment (Amador, Miles, & Peters, 2006).

The cognitive revolution of recent decades has induced the majority of researchers to think in cognitive rather than motivational terms. Few studies have been dedicated to investigating dispositions' role in self-regulation within a PBL environment. For this study, the researchers chose a blended-learning environment as one of the three areas of study, specifically because of e-campus's environmental capabilities to offer students more options during the PBL process. E-campus is an online course-management system that allows professors to post grades, information, and assignments. Instructors and students can also hold synchronous discussions via chat rooms. It is an interactive, Web-based educational tool used to supplement or replace traditional classroom learning, transforming courses into blended-learning environments. In addition, e-campus is a Virtual Learning Environment (VLE). It is an electronic tool that can be accessed by computers both on and off campus, and e-campus is used for teaching and also learning support and development. Current research reports the flexible nature of blended-learning environments (Garnham & Kaleta, 2002; Vaughan, 2007). Thus, for this study, students' academic achievement and self-regulatory processes were analyzed within three different types of learning environments.

There is a need for this study to address the perpetual concern of an ill-prepared workforce, and one can address this issue in numerous ways. The researcher chose to investigate higher education's role in the matter. The instructor's choice of pedagogy invariably affects the dynamic of the classroom in terms of teacher-student interaction. Higher-education students possess the ability to self-regulate; however, how a student self-regulates and to what level depends upon many factors. In addition, clearly, individual students possess the ability to achieve academically, but to what level that student achieves, again, depends upon many factors. One of the factors that can impact a student's academic achievement and self-regulation in diverse ways can be the instructional methodology chosen by the instructor to teach the content of the course. According to Larson and Sung (2009), there is a need to focus research on course design and motivation regarding delivery modes of instruction. This study was designed to investigate the impact of different teaching methodologies and perhaps discover beneficial teaching methods that could potentially play a role in the solution to the perpetual problem of an ill-prepared workforce.

According to Russell et al. (2003), traditional teacher preparation programs need to be altered because of perceived insufficiency. Many faculties of education are undergoing reform, attempting to better prepare teachers for teaching through a standards agenda, including the area of communication and technology (Evertson & Weinstein, 2006). Therefore, during that attempt for change, it is imperative to understand issues of curriculum and instruction. For example, in a PBL design, an important finding to note is the notion that there is a need for more flexibility when conducting PBL courses. Goodnough (2005) concluded that "[i]t may be preferable for each PBL group to have an experienced, full-time tutor; however, in most undergraduate education programs, this is not possible" (p. 299). Reports from students enrolled in a PBL traditional face-to-face classroom explained that when searching for information, the research step of PBL required large amounts of time resulting in slowing down the groups' efforts, causing frustration (Cruickshank & Orlander, 2002). Interestingly, concurrent reports overwhelming revealed time flexibility as being the most well-liked feature from students enrolled in a hybrid course (Garnham & Kaleta, 2002).

Three key points emerged from the abovementioned findings in the research in relation to areas of improvement within higher education's learning environments. These included the need for improvement in higher-education course-curriculum design for learning; the need reported by students for more time when learning, specifically via PBL; and the need for more research in the area of students' motivation/critically thinking levels. This study incorporated investigating a blended problem based teaching methodology and the impact on students' self-regulatory processes.

REVIEW OF LITERATURE

Individuals have the capability to adjust their behaviors based upon social demands. Regulation means changing a behavior to meet a goal. There are four ingredients to self-regulation, including standards, monitoring, will-power, and motivation. Motivation refers to a drive, urge, or impulse to do something. A student can fail to self-regulate if he does not care about reaching the goal. Heatherton & Vohs (1998) concluded that when selfish motivations emerge, self-regulation can be used to restrain impulses to serve the goal of being accepted by others.

Problem-Based Learning

Advantages of using a PBL method of instruction include fostering student problem-solving skills, critical thinking skills, and research skills (Camp, 1996). PBL promotes collaborative learning, which allows for small group discussions and reflections (Daiute & Dalton, 1993). It promotes a deep level of processing and learning (Dominiowski, 1998). PBL works well to help develop better problem-solving skills for future workforce employees (Amador et al., 2006).

The most applicable and relative meta-analysis to date, in relation to the field of education, has derived from Walker & Leary (2009). Teacher-education studies results were included within the analysis process of 82 studies, along with allied health, business, engineering, medical education, science, social science, and kinesiology. Forty-seven of the studies fell outside of the medical and allied health field. The researchers were concerned with the type of implementation of PBL and its effects on learning outcomes. The purpose of their analysis was to investigate a variety of disciplines and assessment levels in PBL outcomes. The vote count analysis revealed that 68 studies showed positive outcomes in favor of PBL. Of utmost interest were the teacher-education PBL studies, which revealed positive outcomes. In contrast to those findings were parallel outcomes revealed when comparing PBL and lecture-based outcomes within the discipline of engineering. In addition, the results were not promising in the area of medical education. Walker and Leary explained that teacher-education program developers should be encouraged by these findings, but there is a clear need for additional quantitative,

controlled studies in teacher education. They concluded that concept-level outcomes were mostly parallel between PBL and lecture while findings were positive for PBL at the principle and application level.

Not only is the majority of the research on PBL centered on medical students and gifted education, the minimal amount of studies that exists outside of these two disciplines focuses mainly on areas of flexible knowledge, effective problem solving, critical thinking skills, and self-directed learning skills. PBL has gained much interest of educators because of its potential for motivating students and transference of learning (Hmelo-Silver, 2004). However, studies on the goals of PBL assisting in developing critical-thinking dispositions and motivation are underappreciated in the field of education.

The few studies outside the discipline of medicine included a study conducted by Hmelo in 1995 on students in an engineering PBL course whose factual knowledge and problem-solving skills, when measured, showed increases for both components. Also, in 1998, Schwartz and Bransford conducted a study on students in a PBL psychology course whereas the researchers concluded that students solving problems before the lecture performed better on problem-solving tasks than those students who only read the chapter with lecture or who just solved the problems. This suggests that a particular combination of lecture and PBL could be beneficial for student achievement. In addition, Derry et al. (2002) revealed that students in a pre-service teacher-education course, utilizing video problems and a Web-based information resource, applied more appropriate concepts and produced more refined explanations when measuring learning outcomes of the problem-based assessment.

Critical Thinking Dispositions

In order for successful critical thinking to take place, one must have attained the "will" (disposition) and the "ability" (skills) to evaluate a situation critically. Critical thinking may be distinguished, but not separated, from emotions, desires, and traits of mind. Ideally, one develops critical-thinking skills and at the same time the disposition to use those skills to solve problems and form good judgments; however, unfortunately, simultaneous development of the two cognitive processes does not always transpire. For example, one may be said to have poor thinking skills because he does not have all the relevant information, resulting in common errors in judgment (Facione & Facione, 1997).

Unfortunately, weak-sense critical thinking results when individuals possess intellectual thinking skills in isolation, without the intellectual traits of the mind. Without all the proper information, one may make unjustified inferences, use inappropriate concepts, fail to notice important implications, or make quick assumptions. One's thinking may be unclear, inaccurate, imprecise, irrelevant, narrow, shallow, illogical, or trivial due to ignorance or misapplication of the appropriate skills of thinking. Conversely, one's thinking might be said to be poor from the result of a sub-optimal disposition. The dispositional dimension of critical thinking is characterological. The focus for its development would be on the habitual intention to be truth-seeking, open-minded, systematic, analytical, inquisitive, confident in reasoning, and sensible in making judgments. For those who are ambivalent on one or more of these aspects of the disposition toward critical thinking, or who have an opposite disposition (intellectually arrogant, bias, intolerant, disorganized, lazy, heedless of consequences, indifferent toward new information, mistrustful of reasoning, or imprudent) are more likely to encounter problems in using their critical thinking skills, or are even less likely to even engage problems using their critical thinking skills. Failure to recognize the relationship between thinking, feeling, wanting, and traits of mind can easily lead to various forms of closed-mindedness. It is imperative to recognize poor critical thinking dispositions, because without intervention, it can lead to various forms of self-deception, both individually and cooperatively (Facione & Facione, 1997). Strong-sense critical thinking requires intellectual humility, empathy, integrity, perseverance, courage, autonomy, and confidence in reason. Thus, critical thinking without essential intellectual traits often results in clever but manipulative and often unethical or subjective thought. The relationship between critical-thinking skills and critical-thinking dispositions is a concept to investigate. People can have both elements in profusion, while some individuals may have neither the will nor the skills to complete a particular task. Interestingly, some may have skills but not the disposition to use them while some individuals are willing to behave in certain ways but lack strong skills. The key is that the teacher who fosters critical thinking should foster reflection in students by asking questions that stimulate thinking essential to the construction of knowledge, which is what PBL promotes (Facione & Facione, 1997).

Blended Learning

Blended course design is combining aspects of a distance online course with the aspects of a traditional face-to-face classroom course. "Blended learning should be an integration of constructivist teaching methods with face-to-face learning in a classroom within an e-learning environment." (Donelly, 2006, p.112).

Numerous researchers are reporting positive results utilizing PBL across disciplines (Schwartz & Bransford,

1998; Derry et al., 2002; Hmelo & Silver, 2004; Downing et al., 2009), additional researchers are reporting positive benefits within blended-learning environments (Aycock, Garnham, & Kaleta, 2002; Fanter, 2002; Dziuban et al., 2004; Garrison & Kanuka, 2004; Williams, 2009; U.S. Department of Education Report, 2009). Higher education must reflect upon technology's role in providing more successful learning environments. It has been suggested that technology may be beneficial in adapting PBL for specific disciplines (Hmelo-Silver, 2004). Larson and Sung (2009) sum it up best with the conclusion that research needs to shift towards how we use the technological medium along with combined factors of course design and student motivation rather than delivery mode. It is critical then, to focus studies on the types of environments provided for learning. It seems logical to investigate constructivist environments, such as implementing the PBL process to present course material, given the reports of positive results, but taking it a step further and investigating the combination of PBL within a blended-learning environment might reveal an even more successful learning environment. In addition, it seems applicable to study the above mentioned within the field of education with findings such as Walker and Leary's (2009) regarding the notion that teacher-education studies utilizing PBL are doing very well when compared to other disciplines. However, in order to create successfully combined learning environments, the issues that have emerged in the past regarding PBL and technology must be addressed.

Goodnough indicated that one major area of weakness regarding PBL course design came from limited time when students were presented course information through PBL. Students reported that time spent locating resources seemed to be an issue of concern whereas 50% of the students reported needing more time to work on their problems, yet others reported needing less time. Fortuitously, a noteworthy point in the area of strength for blended-learning environments was the theme of flexibility that has recently emerged from the research. Researchers explain that students overwhelmingly reported time flexibility as the most well-liked feature of hybrid and blended courses (Fanter 2002; Aycock Garnham, & Kaleta, 2002). Also, Dziuban et al. (2004) concluded, after evaluating several studies related to blended courses that the blended students retain information equal to those enrolled in a traditional face-to-face course. This implies that blended-learning must be strategically combined with successful researched-based teaching methods in order to see positive results utilizing its features when compared to traditional-learning classrooms. It may be extremely advantageous to integrate E-campus into the step-by-step process of PBL and utilize this technology as a tool for forging more successful learning environments.

THE STUDY

For this study, the research design chosen was a quasi-experimental non-randomized pretest/posttest group design. The purpose of this study was to investigate the impact of students' the "disposition" and the "ability" to evaluate a situation critically and academic achievement after learning within three different environments, which included instructing one group of students in a traditional lecture format, a second group of students within a PBL environment, and a third group of students within a blending PBL environment, allowing the students to use the information communication features of e-campus during the PBL process. The following research questions guided this study regarding the impact of various teaching methods on students' academic achievement and self-regulatory processes.

1. Are there significant differences in academic achievement among students learning via three different teaching methodologies: problem-based learning (PBL), blended problem-based learning (B-PBL), and traditional face-to-face lecture classroom instruction?

2. Are there significant differences in critical thinking dispositions among students learning via three different teaching methodologies: problem based learning (PBL), blended problem-based learning (B-PBL), and traditional face-to-face lecture classroom instruction?

METHODOLOGY

Population & Participants

The accessible student population for the study was 150 undergraduate nursing major students enrolled in a regional campus of a science and technology institute in 2014. These students were mostly in their freshman and sophomore year, aging between 18 and 23. They were expected to vary in their educational experience prior to entering the university. English for Nursing Purposes (ENP) is a required course which is offered year-round. Most students take this course during their first or second year of study. An average class size is close to 50 students. The researcher instructed all three classes, however, utilized different instructional methodologies within each of the three sections. Students who took the class were encouraged to participate in the study. Voluntary participation was ensured both through explicit verbal and written explanations. The participants could withdraw from the study at any time and that their participation would in no way influence their academic standing in the class where the questionnaires were distributed. Participants were informed verbally and in

writing that they could decline to answer any items on the questionnaire. The subjects gave their consent by completing and returning the questionnaire. A total of 150 questionnaires were administered and 120 were returned, resulting in a response rate of 80%.

Instrumentation

Comprehensive Exam

Students were administered one comprehensive course-content pretest and one comprehensive course-content posttest. The pretest/posttest contained 45 questions pertaining to content of the course for the semester. The questions were extracted from the course textbook.

Reliability

A split-halves method was used to test the reliability the comprehensive exam. The researchers asked 30 students who agreed to participate. The Spearman-Brown coefficient revealed .76, indicating a strong reliability and is suitable for evaluating individuals if averaged with several other scores of similar reliability. In addition, a Cronbach's alpha reliability test, an internal consistency reliability test, revealed a good reliability coefficient of .85.

Validity

Chapter questions extracted from the concepts within the course textbook that have been created by experts in the field of English for Specific Purposes (ESP), and several long-term full-time professors and lecturers of the Department of Nursing. To establish the content validity of the items in the pretest/posttest comprehensive exam, experts in the fields of Applied English and Nursing were asked to help identify content necessary for assessment of academic achievement. They were also asked to validate the content of the instrument and review for things such as unclear instructions, confusing, ambiguous or repetitive items, and/or overly complex or difficult sentence structure. The researchers then revised the instrument based on the constructive feedback received from the reviewers.

The California Critical Thinking Disposition Inventory

According to the Mental Measurements Yearbook, the California Critical Thinking Dispositions Inventory (CCTDI) was designed to assess the affective, attitudinal dimension of critical thinking. The recommended use of the inventory is for student assessment and program evaluation. It was stated that the CCTDI is not a measure of critical-thinking ability or skills; however, it is a self-report instrument designed to assess measures of personal attitudes and attitudes characteristic of the ideal critical thinker. For example, a person may value being objective, but not be able to achieve objectivity, or a person may be disposed toward approaching problems analytically or in an evaluative manner but lack the ability to adequately use the critical-thinking skills required to do so (*Merker, 2007).* Figure 1 below illustrates the conceptual framework of CCTDI.

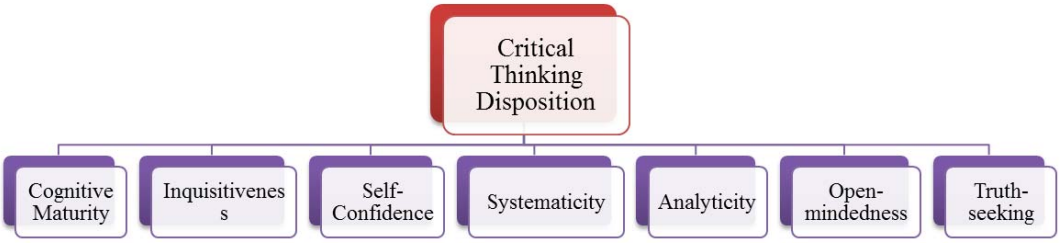

Figure 1. Conceptual framework of CCTDI

Reliability

According to Facione et al. (2000), the internal consistency reliability for the seven individual scales in their initial CCTDI pilot sample ranged from .71 to .80, with the alpha reliabilities for the total score on the CCTDI**.** Cronbach alpha's are reported as falling between .90 and .91 across college students.

Validity

The content validity of the test was based on claims of the items derived from the consensus of 46 theoreticians regarding the dispositional dimension of critical thinking. An original set of 150 statements was reduced to 75 based on the psychometric performance of the items on a pilot version of the instrument. The team of developers for this instrument examined the relationship between the CCTDI and other cognitive constructs. For construct validity, significant relationships were observed between the disposition toward critical thinking and the construct's openness to experience and ego resiliency. Correlations with these constructs and the CCTDI scales

ranged from .25 to .47 ($p<.001$), indicating low to moderate association between the variables under investigation.

Teaching/ Learning Context

Traditional Face-to-Face Procedures

Pretests of comprehensive exam and the California Critical Thinking Disposition Inventory (CCTDI) were administered during week two of this 18-week course. The traditional face-to-face format of instruction consisted of the instructor lecturing while covering chapters one through eight of the course textbook. The instructor lectured, utilizing PowerPoint presentations in addition to distributing PowerPoint handouts to the students during each session. Regarding assessment, during each chapter section, there were some small group (non-PBL) work activities related to the chapters along with outside homework assignments of reading the text chapters and journal-entry review assignments. Each review assignment required the students to read additional information beyond the text, yet related to the chapters. Throughout the semester, students completed a total of four (4) quizzes, each covering two lessons in the textbook. During week seventeenth, students were administered the CCTDI questionnaire posttest. During the week of the finals, a comprehensive exam administered covering chapters one through eight of the text, which was the posttest for this study. Students were asked not to study for this final exam, as the result would not count towards their final grade.

PBL Procedures

The PBL format of instruction consisted of the same instructor taking on the role of the facilitator. A comprehensive course-content pretest and a CCTDI pretest were also administered during week two. Students were divided into groups of five. Each group was assigned the same problem over which they researched and collaboratively discussed. The students worked on problem-based assignments for two to three class periods, depending upon the length of the chapter.

Students completed part of the problem-based process in the computer lab. In addition, there was one class period dedicated to teacher-led PowerPoint whole-group discussion relative to each chapter, following total completion of the problem-based assignment corresponding to the chapter. According to Schwartz and Bransford (1998), students solving problems before the lecture performed better on problem-solving tasks than those students who just solved the problems.

A modified “Seven Jump” for PBL was used for this study. Students received problems each week relative to the chapter of the course textbook. The modified “Seven Jump” process required the students to complete a six step PBL process. First of all, the students defined the problem. Secondly, they brainstormed ideas and solutions to problems in order to activate prior knowledge. Third, they developed learning issues or questions about which they would like to gain new knowledge. Fourth, they researched individually to primarily find a solution to the problem. During the research stage, students were provided with handouts of links to look up on the World Wide Web. The fifth step involved the group reconvening, in order for discussion of findings. All five steps were completed during a two-hour class period. The following class period was scheduled for whole group discussion. Between the PBL assignment and whole group discussion, the students completed the sixth step. This step required the participants to individually write a one-page journal entry, explaining how their group decided to solve the assigned problem, during their in-class collaboration step of the PBL process. Students submitted a one-page reflection at the beginning of the following class discussion period. These procedures were consistently followed for each of the eight problems, relative to textbook chapters, presented over the 18-week semester. Table 1 below illustrates a sample English for Specific Purposes (ESP) class format of a conventional PBL. In week seventeenth, students were administered the CCTDI questionnaire posttest. During the final’s week, students were again administered a comprehensive course-content posttest covering chapters one through eight of the text.

Table 1. Sample Class Using A Conventional PBL Format on *Oncology* unit

PBL Step	**Class Period/ Place/ Duration**	**Procedures**
	Before Class	1. Students will read a medical column/admission note relative to the chapter/unit. 2. Problems provided to students before class, i.e. ● What is the Oncology Unit? ● What are different types of cancer? ● What are the stages of tumor development? ● How is cancer treated? ● What are some possible side effects of Chemotherapy? Etc.

1 (Define)	Class 1/ Classroom & Lab./ 2 hrs	1. Watch Video Clips of (Hawthorne and/or ER) 2. Students define the problems received prior to class
2 (Brainstorm)		Students brainstorm ideas and solutions to activate their knowledge.
3 (Develop)		Students develop learning issues/questions about which they'd like to gain knowledge, i.e. ● Conduct an admission interview ● Communicate with the patients during hospitalization ● Talking about side effects after treatment ● Discharge teaching ● Language useful for explaining medication
4 (Research)		Students research individually to find solutions to the problem(s).
5 (Reconvene)		Group members reconvene to discussion their findings
6 (Discuss)	Class 2/ Classroom/ 2 hrs	Whole group discussion, including completion of a collaborative one-page reflection.

Blended-Problem-Based Learning (B-PBL) Procedures

Pretests of comprehensive course-content and CCTDI were administered in week two. The B-PBL environment required the students to follow the same PBL steps; however, the approach was diverse. The main difference for the B-PBL process was the flexible nature of technology, allowing for more time and a break between steps. The theme of PBL flexibility issues reported from the research (Cruickshank & Orlander, 2002; Goodnough, 2005) was taken into account with the notion that students indicated needing more time for thorough completion of the PBL process. The students did not complete all five steps of the PBL process in one class period as described above in PBL group. Rather, the B-PBL students were allowed the opportunity to complete steps 1-4 only at their own pace during the entire two-hour class session, depending upon the length of time each group needed to work. Step 5 of PBL process was separated from the other steps and completed outside of class within E-campus's chat room. This type of blended teaching methodology offered the groups an opportunity for more time to complete the PBL process based upon how their group operated and completed tasks, lowering frustration levels.

In addition to using the chat room feature of E-campus, students used supplemental information communication features of E-campus. They used the discussion forum to post questions and times for students to meet regarding their PBL assignments, allowing for alternative communication outside the classroom. Also, during the B-PBL process, students used the technological convenience of E-campus's information-communication features to download PowerPoint presentations, PBL assignment sheets, and research links. During the research stage, students were provided with links through E-campus's posting features, which served a purpose to save time during the in-class step 4. After completing the chat session step 5 from the students' computers at home, the students were asked to write a collaborative group reflection as step 6 as their homework assignment. Students were given a CCTDI posttest and a final comprehensive test in their designated time.

Data Analysis

The statistical data analysis used for the comprehensive exam data scores were parametric statistical techniques. The CCTDI is a self-report instrument designed to assess students' affective, attitudinal dimension of critical thinking.

MANOVA / ANOVA /ANCOVA

The dependent variables for this study were academic achievement and critical-thinking dispositions. The independent variables were three different instructional modalities, including traditional face-to-face lecture, PBL, and B- PBL. In order to test for statistical differences, an ANOVA was used on the pretest/posttest comprehensive exam for the three groups of students being taught via different teaching methodologies. A Multivariant analysis (MANOVA) was used on the pretest/posttest subcategory scores relative to self-regulation. MANOVA was initially run to test for significant differences at the pretest for the CCTDI. When significant differences were noted among the groups at the pretest, the researcher must consider the Analysis of Covariance (ANCOVA), given that the sample population was not randomly selected. Statistical analysis was performed using the most current version of Statistical Package for Social Sciences (SPSS) for Windows.

FINDINGS

Research question one asked: "Are there significant differences in academic achievement among students

learning via three different teaching methodologies: problem-based learning (PBL), blended problem-based learning (B-PBL), and traditional face-to-face lecture classroom instruction?"

Table 2 shows the descriptive statistics for students' academic achievement scores on the comprehensive exam. The B-PBL group had the highest mean average of 79.13, while the traditional group had the lowest mean average score of 65.34 on the posttest.

Table 2. Descriptive Statistics Comprehensive Exam Pretest/Posttest Scores for Academic Achievement

	Group	Mean	SD	n
Pretest Academic Achievement	PBL	21.17	8.30	40
	B-PBL	25.48	8.68	39
	Traditional	24.10	8.51	41
Posttest Academic Achievement	PBL	70.37	10.71	40
	B-PBL	79.13	12.50	39
	Traditional	65.34	11.62	41

No statistically significant differences were found by the ANOVA test on students' pretest scores. However at the end of the study, based upon posttest scores, as illustrated in table 3, the groups were significantly different, $F = 10.83$, $p < .05$.

Table 3. ANOVA for Comprehensive Exam Pretest/Posttest Scores for Academic Achievement

		Sum of Squares	f	Mean Square	F	Sig.
Pretest	Between Groups	295.002	2	147.501	2.042	.14
	Within Groups	6284.598	117	72.237		
Posttest	Between Group	2935.098	2	1467.549	10.825	.00*
	Within Groups	11795.002	117	135.575		

A post hoc Tukey HSD multiple comparison test was necessary to determine group differences after significant differences in scores were revealed. Table 4 illustrates the data for the Post Hoc Tukey HSD individual between group comparisons at the posttest for academic achievement. There was a significant difference between the B-PBL group and the PBL group at the posttest with $p < .05$. The B-PBL teaching methodology was shown to have a significant impact on the students' academic achievement posttest scores. In addition, the B-PBL group had significantly higher posttest scores than that of the PBL and the traditional groups.

Table 4. Tukey HSD Post Hoc - Individual Comparisons between Groups at Posttest for Different Teaching Methodologies Impact on Academic Achievement (n=120)

Time	Group(I)	Group(II)	Mean Difference	Sig.
Posttest	B-PBL	PBL	8.76	.01*
	PBL	Traditional	5.02	.23
	B-PBL	Traditional	13.78	.00*

Research question two asked: "Are there significant differences in critical thinking dispositions among students learning via three different teaching methodologies: problem based learning (PBL), blended problem-based learning (B-PBL), and traditional face-to-face lecture classroom instruction?" The purpose of question two was to determine what kind of impact problem based learning, blended problem based learning, and traditional methods of instruction had on students self-regulation skills, and more specifically to determine the impact of these three different teaching methods on students' attitudes and attributes of how "willing" and able they are to think critically.

CCTDI overall scores below 240 were considered very low scores for undergraduate university populations. Scores ranging between 240 and 350 indicated that the student was transmitting inconsistent attitudes towards or vague assessment of higher order thinking. These mid-level scores were characteristic of students whose cognitive development was still evolving. At the pretest, the PBL group's overall mean scores ($M = 278.93$), the B-PBL group's overall mean scores ($M = 285.84$), and the traditional group's overall mean scores ($M = 282.90$) were all indicative of mid-level scores and students expressing ambiguous valuation of higher order thinking. At the posttest, the PBL group's overall mean scores ($M = 280.13$), the B-PBL group's overall mean scores ($M = 286.00$), and the traditional group's overall mean scores ($M = 283.34$) were all, once again, indicative of mid-

level scores and students expressing ambiguous valuation of higher order thinking. Table 5 shows results of the MANOVA used to determine if students' pretest and posttest scores on the CCTDI were significantly different among the PBL, B-PBL and Traditional groups. The results indicated no significant differences among the groups in critical thinking dispositions for truth-seeking, open-mindedness, analyticity, systematicity, confidence, inquisitiveness, and maturity at both the pretest and posttest.

Table 5. Multivariate Tests - MANOVA Pretest / Posttest Scores for the CCTDI

Effect	Value	F	Hypothesis df	Error df	Sig.
Pretest Pillai's Trace	.17	1.10	14.00	168.00	.36
Posttest Pillai's Trace	.16	1.00	14.00	164.00	.45

CONCLUSIONS

This quasi-experimental study was designed to investigate the impact of different teaching methodologies on academic achievement and critical thinking dispositions of the undergraduate nursing major students. The findings for academic achievement of course content revealed higher scores for all groups from pretest to posttest. The B-PBL showed statistically significant higher test scores over the PBL and traditional group at the posttest. However, no significance was found among the groups in critical thinking dispositions for categorical variables at both the pretest and posttest. Blended problem based learning strategies did not have a positive impact on critical thinking dispositions.

Consistent negative reports, acknowledging the deficiencies of new entrants and an ill-prepared workforce should be a major concern of higher education. It is critical for higher education to be more strategic and focused on efforts to scrutinize potential solutions to these deficiencies. Higher education instructors have the choice as to what methods of instruction they would like to expose their students to that could potentially help with the reported deficiencies. An instructor's choice of teaching method is an important factor for determining successful learning environments. For example, the PBL choice of teaching method has been known to foster successful learning environments for critical thinking skills for medical students. However, numerous researchers report both positive and negative results utilizing PBL across disciplines (Schwartz & Bransford, 1998; Derry et al., 2002; Hmelo & Silver, 2004; Goodnough, 2005; Downing et al., 2009). Much of the negative feedback from students regarding PBL revolve around time limitations. Because negative feedback exists in the research from students regarding time limitations within PBL environments, it is critical to address this issue.

In regards to blended learning environments, where technology is used in combination with face to face learning, researchers are reporting positive benefits within blended-learning environments (Aycock, Garnham, & Kaleta, 2002; Fanter, 2002; Dziuban et al., 2004; Garrison & Kanuka, 2004; Williams, 2009; U.S. Department of Education Report, 2009). Higher education must reflect upon technology's role in providing more successful learning environments in conjunction with other teaching methods, for example, PBL. It has been suggested that technology may be beneficial in adapting PBL for specific disciplines (Hmelo-Silver, 2004). Larson and Sung (2009) sum it up best with the conclusion that research needs to shift towards how we use the technological medium along with combined factors of course design and student motivation rather than delivery mode. The focus for this study was the impact of three different types of teaching methodologies on students' academic achievement and self -regulation. One of the three teaching methodologies chosen for this study was designed specifically in order to investigate the impact of utilizing PBL in conjunction with information communication technology. Technology was used in conjunction with problem based learning as a strategy to allow for flexibility in this particular study. In this case, the delivery mode of technology was not studied, but rather how the technological medium combined with problem based learning impacted student's academic achievement and critical thinking dispositions.

Dispositions are affinities or tendencies to use obtainable existing skills. Students who develop critical thinking dispositions are prone to use critical, reflective thinking during problem solving and analysis across various domains (Facione , Facione, & Giancarlo 2000). It is worth mentioning that a student's ability is not sufficient to predict how he or she will act. Critical thinking dispositions are part of an attitude memory that can take considerable experience and time for the development of that attitude strength. PBL can facilitate the development of attitudes towards using critical thinking skills given that PBL allows students to have a stake in their own learning and share multiple perspectives on problem solving with others. The results of the study revealed no significant differences in critical thinking dispositions scores between groups at the pretest or posttest. Tiwari et al, 2006, found significant differences in critical thinking dispositions between a PBL group

and traditional lecture group during a two- year period with contact exposure of 3 to 6 hours per week, while each group was facilitated by a PBL tutor. After a total of 2 years of PBL treatment, results indicated that students in the PBL group scored significantly higher than the traditional group on two of the seven subscales, which were truthseeking and analyticity. The findings from the current study did not support that of Tiwari et. al's. A possible explanation for this finding could indicate the need for long-term exposure to B-PBL environments before results could reveal significant changes in attitude towards the usage of critical thinking skills. In addition, students may need to receive more one-on-one guidance from an individual tutor during the PBL process. For the current study, the instructor was the only professional support provided for the students during the PBL process. Individual tutors were not provided during the online chat or during the in-class discussions.

RECOMMENDATIONS FOR FUTURE STUDY

The findings of the present study indicated that the use of blended problem based learning enhanced academic achievement. One recommendation would be to obtain and analyze data from a larger population accomplished through a longitudinal study. For example, expose two different groups of students, one to the B-PBL group described in this study, and one to a different combination of PBL and blended learning techniques. Exposure to the two environments should be for an extended period of time, such as, over a 2-year period and then test students' critical thinking dispositions in a course.

This study was restricted by an education curriculum and three groups of college nursing students. Further studies could be conducted within different disciplines and with different class levels regarding different combinations of using ICT and PBL. Another recommendation would be to conduct a qualitative study on student's views regarding the usage of E-campus as part of the PBL process. For example, subjects could be asked about their feelings regarding group work pros and cons during E-campus chats. In addition, how students felt about the B-PBL methodologies of instruction could give educators some insight into why certain critical thinking elements were or were not significantly enhanced in the B-PBL group.

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REFERENCES

Amador, J. A., Miles, L., & Peters, C. B. (2006) *The practice of problem-based learning: A guide to implementing PBL in the college classroom.* Bolton, MA: Jossey-Bass.

Aycock, A., Garnham, C., & Kaleta, R. (2002). Lessons learned from the hybrid course project. *Teaching with Technology Today, 8*(6), 22-33.

Ballard, S., Stapleton, J., & Carroll, E. (2004). Students' perceptions of course web sites used in face-to-face instruction. *Journal of Interactive Learning Research*, *15*(3), 197-211.

Camp, G. (1996) Problem-Based Learning: A Paradigm Shift or a Passing Fad? *Medical Education Online*, 1(2). Retrieved from http://www.personal.psu.edu/wxh139/PBL.htm.

Cruickshank, B.J. & Olander, J. (2002). Can problem-based instruction stimulate higher-order thinking? *Journal of College Science Teaching, 31*, 374-377.

Daiute, C. & Dalton, B. (1993). Collaboration between children learning to write: Can novices be masters? *Cognition and Instruction, 10*, 281-333.

Derry, S. J., Siegel, M., Stampen, J., & the STEP Research Group (2002). The STEP system for collaborative case-based teacher education: Design, evaluation and future directions. *Proceedings of computer support for collaborative learning (CSCL)* (pp. 209-216). Mahwah, NJ: Erlbaum.

Dominowski, R. D. (1998). Verbalization and problem solving. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Metacognition in educational theory and practice* (pp. 25-45). Mahwah, NJ: Lawrence Erlbaum.

Donnelly, R. (2006). Blended problem-based learning for teacher education: Lessons learnt.*Journal of Learning, Media and Technology*, 31, (2), 93-116.

Downing, K., Kwong, T., Chan, S., Lam, T., & Downing, W. (2009). Problem-based learning and the development of metacognition. *Higher Education, 57*(5), 609-621.

Duch, B. J., Groh, S. E., & Allen, D.E. (2001). *The power of problem-based learning: A practical ``How To'' for teaching undergraduate courses in any discipline*. Sterling, VA: Stylus.

Dziuban, C.D., Hartman, J.L., & Moskal, P.D. (2004). Blended learning. *EDUCAUSE Center for Applied Research Bulletin, 7*, 112.

Evertson, C. M. & Weinstein, C. S. (2006). *Handbook of classroom management: Research, practice, and contemporary issues*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Facione, P. A., Facione N. C, & Giancarlo C. A.. (2000). The disposition toward critical thinking: Its character, measurement, and relationship to critical thinking skill. *Informal Logic*, *20*(1), 61-84.

Facione, N.C. & Facione, P.A. (1997). Critical thinking assessment in nursing education programs: An aggregate data analysis. Millbrae, CA: The California Academic Press. Fanter, Amy. (2002) Hybrid education: The future of instructional models. *World Wide Learn*. Retrieved from http://www.worldwidelearn.com/education-articles/hybrid-education.html.

Fanter, Amy. (2002) Hybrid education: The future of instructional models. *World Wide Learn*. Retrieved from http://www.worldwidelearn.com/education-articles/hybrid-education.html.

Garnham, C. & Kaleta, R. (2002). Introduction to hybrid courses. *Teaching with Technology*. Retrieved from http://www.uwsa.edu/ttt/articles/garnham.htm.

Garrison, D. R. & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education, 7*(2), 95-105.

Goodnough, K. (2005). Issues in modified problem-based learning: A self-study in pre-service science-teacher education. *Canadian Journal of Science, Mathematics, & Technology Education, 5*(3), 289-306.

Heatherton, T. F. & Vohs, K. D. (1998). Why is it so difficult to inhibit behavior? *Psychological Inquiry, 9*, 212-215.

Hmelo, C. E. (1995). Problem-based learning: Development of knowledge and reasoning strategies. Markman (Ed,). In *Proceedings of the Seventeenth Annual Conference of the Cognitive Science Society (pp. 403-408)*. Mahway, NJ: Lawrence Erlbaum Associates .

Hmelo-Silver, C. E. (2004). Problem-based learning: what and how do students learn? *Educational Psychology Review*, *16*(3), 235-266.

Larson, D. K. & Sung, C. H., (2009). Comparing student's performance: Online versus blended versus face-to-face. *Journal of Asynchronous Learning Networks, 13(1)*, 31-42.

Russell M., Bebell D., O'Dwyer L., & O'Connor, K. (2003). Examining teacher technology use. *Journal of Teacher Education*, *54*(4), 297-310.

U.S. Department of Education (2009). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. Retrieved from http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf [December 2009]

Vaughan, N. (2007). Perspectives on blended learning in higher education. *International Journal on E-Learning*, *6*(1), 81-94.

Walker, A. & Leary, H. (2009). A problem based learning meta-analysis: Differences across problem types, implementation types, disciplines, and assessment levels. *Interdisciplinary Journal of Problem-Based Learning*, *2*(1), 12-43.

Williams, B. (2009). Do undergraduate paramedic students embrace case based learning using a blended teaching approach? A 3-year review. *Australasian Journal of Educational Technology, 25(3)*, 421-439.