

Research Article

The Student Perspective: Using Explicit Instruction and Technology for Critical Thinking Development

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Abstract

A mixed methods research study explored critical thinking development with nursing students. Critical thinking was explicitly discussed, integrating instructional strategies with course domain knowledge. Questions developed for use with instructional technology aimed at higher level thinking to facilitate student development of critical thinking. Students were surveyed to gain their perspective of the educational strategies used. Student online discussions were assessed for critical thinking with qualitative content analysis using three approaches for triangulation of findings. Thematic analysis of open-ended student survey responses informed on their perspective of critical thinking. Inclusion of a critical thinking skills tests provided appraisal of critical thinking. The use of three methods of data collection and analysis offered comprehensive understanding of findings. Students were appreciative of technology use in delivering course information and supporting their development of critical thinking. Two forms of technology were beneficial in offering alternate means to actively participate in learning, and meeting different needs and preferences. Students noted alignment of critical thinking instruction with subject-specific content to facilitate understanding, application, and relevance of course material to their learning. While the findings are limited to students in the study, the instructional strategies can provide basis for course design and implementation for critical thinking development.

Keywords: Critical thinking; Inquiry; Technology

Introduction

Critical thinking is highly acclaimed in today's educational and professional arenas - a valuable asset for students graduating from higher education programs [1-4]. Technology has advanced in quantity and quality, leading to familiarity with its utilization as a significant requirement of 21st century learners. Technological advancements, increasing information overload, coupled with the need to maintain professional expertise and research knowledge has become a challenge for educators and students in the healthcare field [5]. Professionals in healthcare practice are expected to be discerning and resourceful, accessing electronic resources, locating information, and being able to integrate it into patient care promptly as needed. The capability to critically think is considered of great importance for functioning in today's fast-paced, complex work environments, especially in healthcare. Accordingly, it is essential that critical thinking capability be initiated and cultivated during the formal educational process when students are in higher education [6,7].

The growing use, diversity, and prevalence of digital technology

in the workplace and in higher education support the need to develop learning environments enhanced by technology. Educators have placed emphasis on integrating technology into education, reflecting its importance for institutions, educators and graduating professionals [8-10]. However, enhancing educational practices with technology does often mean instructors must undertake a change in how they teach, potentially shifting from an instructions approach to a constructivist approach [11,12]. Technology integration into education can be innovative and disruptive [13]. The utilization of technology in teaching and learning accordingly offers novel educational opportunities, but entails change and unsettles traditional practices. While it is important that technology use be integrated into students' learning environments, this integration into education must be driven by pedagogy, and shaped by methods of instruction and the learning activities created, not led by the technology itself [14,15]. Acquiring knowledge of student perspectives of instructional strategies and technology use in their learning can help support educators design and implement courses to develop critical thinking beneficial to students.

Research Study

While critical thinking is deemed necessary for graduates from higher education programs, and especially for nursing students embarking into practice in highly acute and complex settings, there is no specific instruction on what it is or how to achieve it in our program. Nurse educators are challenged by how to teach and assess for critical thinking given the numerous definitions in circulation, which is further complicated by the variety of recommended teaching strategies available [6,16,17]. Time, space, acuity, and unfamiliarity with articulating and explaining what critical thinking is can limit achieving valued, constructive teaching and learning in large classrooms and busy clinical settings [3,17,18]. Designing a plan for instruction with strategies recognized to be of benefit to teach critical thinking could contribute to nursing education and prepare students for future practice.

Technology is becoming an integral feature in workplaces and in the healthcare environment. In nursing education, it has also been considered essential, but controversy remains as to how to incorporate it into curriculum [19]. To be capable of adapting and adopting technology as needed, it is important that students become familiar and flexible with its use [19].

A mixed methods research study was therefore undertaken to gain insight into teaching critical thinking with purposeful and appropriate use of technology implemented into a beginning undergraduate course. Qualitative and quantitative data were gathered from the students on their perspectives of the strategies used for instruction to facilitate critical thinking development, and to explore and better understand their experiences of learning through the course. Adopting a pragmatic approach with mixed methods yields the benefits of subjective and objective data collection and analysis, to attain a comprehensive understanding of the topic of research.

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Received: July 12 2017; **Accepted:** August 22 2017; **Published:** August 28 2017

Research questions

This research study was designed to examine two areas of importance to nursing education and nursing practice: (1) critical thinking and (2) the use of technology to facilitate student learning.

The principal question was:

To what extent can incorporating explicit critical thinking instruction and technology contribute to nursing students' development of critical thinking?

Additional questions targeted the student perspective to consider:

- a. How does the use of a classroom response system contribute to the development of critical thinking?
- b. How does critical thinking develop within an online facilitated discussion forum?
- c. What are the learners' preferences for instructional strategies that support their development of critical thinking?

Of significance is the need to graduate critically-thinking students from higher education programs, and to determine most beneficial and appropriate use of technology in education.

Interactions with numerous students of diverse backgrounds at varying levels in their higher education programs has revealed that many students experience difficulty applying their text-based knowledge to real-world situations. Critical thinking capability has the potential to overcome this break between theoretical learning and workplace practice execution – the theory-practice gap [20]. Using a class response system in-class would engage students in active learning and thinking in the moment, while incorporating an online discussion forum will aid the learning process by extending learning. The use of an online discussion provides students with the benefit of time to reflect and critically think about course content. Online discussion forums enable instructors with the opportunity to assess student capability as they must express their thinking and reflections in written form. This is beneficial to promote clear, accurate, and professional written communication. Using more than one strategy to facilitate critical thinking capability recognizes the needs of diverse student learners. Determining factors that contribute to or deter critical thinking development and learning with technology, can help educator's better support student growth.

Research setting and context

The research study was implemented in a beginning nursing course taught by another faculty instructor, with undergraduate students as the participants. There were 127 students enrolled in the class, with the majority being 19 to 20 years of age. All students were involved in the study as the inclusion of critical thinking instruction and the implementation of the technologies were incorporated into the course.

The students were intentionally targeted as being in the early stages of their education. Implementing the study with this class was an opportunity to instill the need for critical thinking within the students as they began to study discipline-specific course content. The implementation of technology-enhanced learning for this study was also an opportunity to further encourage students to develop their capability to learn with technology. Its use in education and future employment is ever present and will likely increase in the future.

The concept of critical thinking was intentionally and explicitly integrated into the course in that it was described and defined for the students to enable their understanding of what they were aiming to achieve; and included: What critical thinking is; how inquiry can support its development; and the correlation between critical thinking and student learning. The classroom response system and the online discussion forum were used to engage and facilitate student learning in class and extend the learning out of class.

Questions were developed to stimulate thinking and promote understanding and application of course content, platformed within the appropriate technology used -- the classroom response system and the online discussion forum. The questions created for the classroom response system as in-class technology, aimed to initiate discussion and further inquiry and thinking. The questions generated for the online discussions as the out-of-class technology used were to further understanding and deepen thinking on course topics.

Ethical considerations

Approval was attained from the Conjoint Faculties Research Ethics Board (CFREB) for this study. The students were informed of the research study before the start of classes through the learning management system, and then again on the first day of classes. They were assured of confidentiality and anonymity. Participants were informed that their responses would contribute to improving the course, and would not be a factor in their grade, thus establishing that there was no risk either way to their choosing to participate or not participate in the study. To ensure informed consent, after being fully informed about the study they were asked to complete a consent form.

Data collection

Data was collected using quantitative and qualitative methods. Quantitative data was acquired from student completion of a standardized proven critical thinking skills test, and from the 25 Likert scale close-ended questions in the end-of-term student survey. The standardized critical thinking skills test chosen was the Health Sciences Reasoning Test (HSRT) as it has demonstrated potential for consistency in assessing for critical thinking and was deemed suitable for this study [21]. The close-ended questions of the survey centered on five foci as aligned with the research questions (See Appendix A).

Qualitative data was generated from the four open-ended questions in the end-of-term student survey (See Appendix A) and the artifacts from the student online discussion postings. The open-ended survey questions collected subjective data that shed light on the factors influencing student learning through the learning strategies implemented in the course. Using open-ended questions offered insight into the learners' points-of-view. Researcher reflective journaling was maintained and included field notes and documentation about course planning, designing, and implementation, and communication exchanges with the course instructor.

Data analysis

Quantitative and qualitative data were collected concurrently, analyzed separately, and synthesized jointly to ascertain validation of the findings. With the variety of data collected, data analysis was dependent on the research method and type of information attained.

Student Survey Data: For the student responses to the Likert scale survey questions, the data was counted and compiled into Excel spreadsheets, denoting number of responses for each of the choices for each question. The number of responses was summed for each choice of the Likert scale, and using the COUNTIFS function, frequency distributions were generated for each of the questions.

Thematic analysis was implemented with the student responses from the open-ended questions of the survey. The open-ended survey questions provided a reflection of student perspectives and understanding of critical thinking as demonstrated through their responses, which included expressions depicting features of critical thinking.

The data collected from the online discussion student postings was amenable to qualitative content analysis. In this study, to determine critical thinking presence in the online discussion postings, qualitative content analysis was founded on the four-stage cognitive presence

Practical Inquiry Model (PIM) [13], Bloom’s revised taxonomy levels of cognitive domain [22], and the critical thinking indicators proposed by Mason [23].

The questions that were asked to initiate the discussion postings represented the triggering event phase of the PIM (See Table 1), and as such, aimed to stimulate critical thinking and facilitate self-inquiry and reflection.

The questions generated for the online discussion postings were developed with intention that they would encourage Bloom’s revised taxonomy levels of applying, analyzing, and evaluating as described in Table 2.

Creating Generating new ideas, products, or ways of viewing things; putting information together in an innovative way

The following questions represent indications of critical thinking as used by Mason [23]:

- Do the participants build on previous messages?
- Do they draw on their own experience?
- Do they refer to course material?
- Do they refer to relevant material outside the course?
- Do they initiate new ideas for discussion?

The PIM, Bloom’s revised taxonomy, and Mason’s critical thinking indicators have been used to identify critical thinking in textual content and demonstrate value of the learning activity [24-26]. It has been proposed that the assessment for critical thinking include more than one classification as confirmation of the capability, and that three methods of content analysis would contribute to improving triangulation [26]. Consequently, all three methods were used to assess the students’ online discussion postings for demonstration of critical thinking.

Practical Inquiry Model (PIM) Descriptors	Description
Triggering event	Questioning or messaging to encourage discussion
Exploration	Awareness of aspects of the issue or problem
Integration	Reflection and deliberation to connect various informational sources, developing potential resolutions/proposals/conceptions
Resolution	Commitment to solution with vicarious application/testing in real world

Table 1: Description of the Phases of the Practical Inquiry Model.

Bloom’s Revised Taxonomy Descriptors	Description
Remembering	Recalling relevant information
Understanding	Explaining ideas or concepts; making sense of what you have learned
Applying	Using information in another familiar situation; using knowledge gained in new ways
Analyzing	Breaking information into parts to explore understandings and relationships; breaking concept into parts to understand how each part is related to one another
Evaluating	Justifying a decision or course of action; making judgments based on a set of guidelines
Creating	Generating new ideas, products, or ways of viewing things; putting information together in an innovative way

Table 2: Summary of Bloom’s Revised Taxonomy Descriptors.

To demonstrate comparable and fair assessment of the online discussions, ten postings were randomly selected and presented to the instructor of the course to assess for critical thinking. As the discussion responses reflected course content, it was important for the assessor to have course knowledge. The summary of the phases and levels of the PIM and Bloom’s revised taxonomy was provided to the instructor as tools for assessing the postings (See Tables 1 and 2). As the whole posting was analyzed as the message communicated, the unit of analysis chosen for content analysis was the message [27]. Holsti’s coefficient of reliability (C.R.), which has been viewed as a simple and more frequently used tool to determine interrater reliability, was used to compare the assessment of postings between the instructor and the researcher to determine percent agreement [27]. This comparison revealed that both the instructor and researcher were conducting fairly similar evaluations of the postings, with a CR of 0.7 using the PIM phases and CR of 0.8 with Bloom’s revised taxonomy. While agreement was not 100%, it established that the researcher assessment of the postings was reasonable and not unfair.

Findings from the Study

Of the 127 registered students, 43 students (34%) completed the end-of-term survey implemented in the last class of the term. Consent to utilize their online discussion postings for the research study was provided by 55 of the 127 students (43%), with the understanding that no identifiers would be used. To gather a representation of student critical thinking capabilities, results were attained from 80 of the 127 students (63%) who completed the critical thinking skills test.

Aligning with the research questions of the study, the analysis generated themes from the student survey responses, the online discussion postings, and the researcher field notes, identifying significant elements for course design and implementation to support student learning and development of critical thinking and purposeful use of technology.

Course Design and Implementation

To create a learning environment enhanced with technology that purposefully cultivates critical thinking, certain elements were included in the course design and implementation: (a) intentionally integrating explicit critical thinking instruction, (b) specifically developing questions for the classroom response system and online discussion which aimed to promote critical thinking associated with course content, and (c) purposefully incorporating the chosen appropriate technology into the course learning activities.

To intentionally integrate critical thinking instruction, information focused on what critical thinking is and its importance to professional practice was delivered to the students to facilitate their understanding of what they were aiming to achieve as they progressed through the course and through their program. Presentations on critical thinking included information that:

- Specifically related critical thinking to nursing
- Emphasized the importance of questioning to guide development of critical thinking
- Connected the level of questioning with the desired level of thinking
- Facilitated student understanding that instructors were modeling the type of questioning that would be useful in supporting their development of self-inquiry for practice

Reflecting content from the classroom critical thinking instruction, the students demonstrated recognition of needing to think, reflect, make connections, apply their learning, and determine why (the reasoning for their decision) when composing their discussion postings:

- “I had to critically think about the topic and create a cohesive

response. It required me to think about the topic and everything that influences the topic”

- “being able to form full thoughts and reasons to support them”
- “think more deeply into class content”
- “helped me reflect on what I have learned in class and apply it”

In specifically developing questions to promote critical thinking, the students noted preferences for certain types of questions encompassing certain content. Of the 43 end-of-term survey respondents, 93% (40) regarded the types of questions and responses utilized with the classroom response system and the online discussions to be beneficial in facilitating their development of critical thinking. Additionally, 69% (30 of 43) of the students did ascertain that the questions implemented with the two technologies required them to use critical thinking to respond.

Of the questions used for the classroom response system, the students identified preferences for questions with multiple correct answers and questions which applied course content to real practice situations, as these questions stimulated discussion and contributed to developing critical thinking. Students identified “applications questions,” “ethical questions, problem-solving scenarios,” “ones addressing current headlines on the news,” and “questions about what factors caused a condition encouraged me to look holistically at the client” as content beneficial to their development of critical thinking.

The online discussion questions that students deemed beneficial involved being asked to incorporate their personal perspective, apply course knowledge, and incorporate practice scenarios. The online discussions were thought helpful in promoting reflection on classroom learning by 60% (26 of 43) of the students. Additionally, 49% (21 of 43) considered the types of question used for the online discussions as helpful to their understanding of the course information. One student summarized how the online discussion questions were supporting her learning:

I like how the discussion questions place us in different situations and in that way, forces us to combine both the lecture material to real life. This helps cement what we learned beforehand and in our readings by making it more personal and thus, more meaningful.

Purposeful integration of different technology

providing different technological approaches to develop critical thinking was deemed beneficial by 65% (28 of 43) of the students who responded to the survey. The students appreciated “different methods of reinforcing my learning” acknowledging that “having both technologies encouraged participation and critical thinking” and “present[ed] two ways of answering questions.”

Meeting students’ diverse learning preferences and needs by incorporating more than one form of technology to support learning provides variety in instructional approaches. This variety also aims to meet the diverse preferences and learning needs of students. From the end-of-term survey data, 54% (23 of 43) of the students agreed that the integration of the classroom response system and the online discussions addressed variety in learning needs. Of the total student responses to this end-of-term survey, 58% (25 of 43 students) preferred the classroom response system while 40% (17 of 43 students) indicated preference for the online discussions as tools to develop critical thinking. A student shared that “I really liked using the classroom response system. It was a great way to test my knowledge.” On the other hand, another student noted that “online discussions were more beneficial because I had to critically think about the topic and create a cohesive response. It required me to think about the topic and everything [that] influences the topic.”

Presence of critical thinking

The thematic analysis of the 43 student responses to the open-ended, end-of-term survey questions reveals that the students identified these ideas:

- Time needed to process learning
- Deeper thinking to gain understanding
- Applying learning and making connections
- Personalizing learning as a means by which they were developing critical thinking

The analysis showed that the student responses did reveal expressions illustrating understanding of critical thinking.

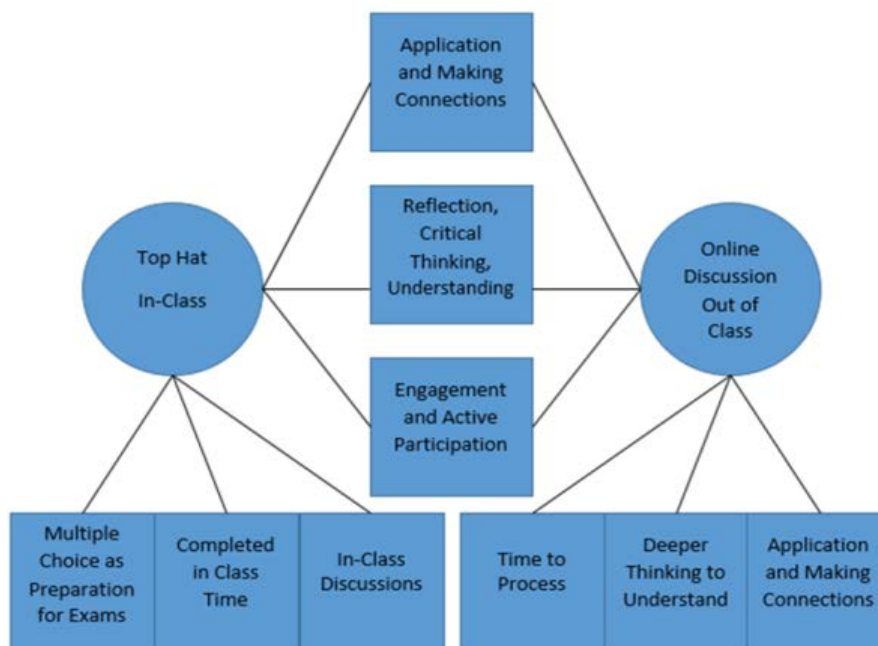


Figure 1: Thematic Analysis of Student Perspective on Developing Critical Thinking using Technology.

Qualitative content analysis of the online discussion postings submitted by the students utilizing the three methods previously described did reveal that students' demonstration of critical thinking. Based on the indicators as presented by Mason [23], the students displayed critical thinking in their discussion posts, referring to course learning and moving towards new ideas and perspectives. Through the lens of the PIM phases, the student posts exemplified exploration and integration, and therefore expressed critical thinking [13,26]. The levels of analyzing and evaluating from Bloom's revised taxonomy also indicated that some students attained critical thinking [22].

The average percentile score for the students completing the critical thinking skills test (the HSRT) was 72, as compared to the results of American national norms for undergraduate nursing students taking the same test [28]. Student participation was at 63% (80 of 127 registered students) for completion of the HSRT. Overall, 64% (51 of 80) of these students demonstrated strong reasoning capacity to reflect and think through relevant information to make quality decisions [28].

In this study, triangulation of data was achieved by using three methods to collect and analyze different forms of information to identify development of critical thinking: through self-perceptions by the students, through content analysis of discussion postings, and through a standardized test (HSRT). Additionally, demonstration of critical thinking through content analysis of the online discussion postings was determined by three approaches to further triangulate the findings.

Discussion

While the findings are limited to the characteristics of the student participants of this study and their perspectives, the potential exists for the findings to inform how similar strategies and tools may apply in alternative situations. The novice undergraduate course was purposefully chosen as the context for this study as critical thinking has been identified as a capability that should be initiated early in a student's educational program. This provides the time and opportunity for students to improve on and incorporate this capability into their learning as they progress through future courses [7]. With the increased use of technology in education and the workplace, gaining familiarity with its use has become an expectation of students and graduates [29-31]. Consequently, these two combined factors were the impetus for this study: the benefits students may gain from developing critical thinking with learning settings supported by technology. An additional intention was to determine approaches and strategies for including technology to enhance learning in the classroom that could be comfortably managed by an instructor, with the potential that this would encourage greater future use of technology to support learning.

Course Design and Implementation

The study findings demonstrate that explicitly and purposefully integrating critical thinking instruction into a course, where the instructional content is specifically aligned with the students' subject area, has potential to assist students in developing their critical thinking capability. The study further shows that integrating explicit critical thinking instruction has possibility in enabling students to recognize the relevancy and importance of critical thinking to their profession. As the course instructor noted: "Overview of the rationale for critical thinking in relation to nursing practice seemed to equip the students with a better understanding of what was expected of them in relation to assessment in the course."

The questions created contributed to this learning process as they connected classroom knowledge to real life situations, and aimed for higher levels of Bloom's revised taxonomy in the students' thinking processes. Linking theory and practice together in this way challenged students to think more fully and deeply and raised their awareness of diverse perspectives.

The students stated that questions with multiple correct answers – as used with the classroom response system – encouraged discussion and facilitated development of their critical thinking. The aim of generating multiple correct answers from the students was to lead them into discussion, and have them consider different scenarios that may be pertinent to their answer. The questions therefore required them to execute a higher level of thinking, beyond merely remembering content (Bloom's lowest thinking level).

The students expressed that being asked for their opinions in the online discussion questions personalized their learning on course content and promoted their reflection and critical thinking. Questions that had them apply and connect their learning to real practice situations were valued by the students, as it helped them bridge theory and practice.

Therefore, to achieve student development of critical thinking, platformed on suitable technology, entails designing and implementing a course that includes the following elements:

- Course content that includes explicit critical thinking instruction (what critical thinking is, questioning and self-inquiry to develop critical thinking, domain-specific importance)
- Establishing supportive learning environments enhanced with technology that are conducive to student learning, and that encourage active participation
- Questions developed to be aligned with domain knowledge that promote inquiry and critical thinking; level of questioning to evoke level of thinking sought
- Training for instructor and students on the use of the purposefully selected technology to support the pedagogical practice

Purposeful integration of different technology

the study findings show that the students found value in having variety in technology as part of the classroom learning tools, noting benefits to learning with different methods such as multiple choice questions with the classroom response system, leading to in-class discussions, and written discussions with the online forums. As noted by a student "I had to physically respond and reflect on the questions, both in my head and on paper/laptop. It's also beneficial to do both MC [multiple choices] and written response." Similarly, the instructor for the course commented that:

The classroom response system provided the students with an opportunity to consider MC [multiple choice] questions whereas online discussion allowed them to apply multiple concepts at one time...they appreciated having exposure to MC [multiple choice] questions for the purpose of studying for the exam whereas the discussion questions helped them to articulate their thoughts about class content in a written manner.

Presence of critical thinking

in this study, the nursing students as a group did demonstrate an understanding of, and exhibited, critical thinking. The critical thinking skills test as a quantitative measure identified strong critical thinking capabilities. This supports the findings from the content analysis of the online discussion postings, which recognized that the written compositions by the students did demonstrate critical thinking, further substantiated by student self-awareness of critical thinking. As metacognitive awareness is beneficial to critical thinking [32], the perception of students of their personal capabilities was important to their understanding and development of critical thinking.

Conclusion

From the research study, information has been gathered from the instructor and student perspective to identify instructional approaches beneficial to the development of student critical thinking. Many students noted that the inclusion of technology to enhance their learning was appreciated, as was having the variety of in-class and online technology to facilitate their development of critical thinking.

Including explicit critical thinking instruction aligned with course content and professional knowledge facilitated student understanding and helped to develop their critical thinking. This was revealed in the findings, where students demonstrated critical thinking. Creating questions aimed at higher levels of thinking generated demonstrations of that level of thinking. The online discussion postings demonstrated analysis and application, and exploration and integration as was the intent of the questions created.

The students' comments showed they appreciated the questions developed for the teaching, as they were relevant to course content and professional practice. This highlights the importance of domain knowledge inquiry in critical thinking development. Questions which asked them to apply their learning and which personalized the learning was deemed helpful to developing their critical thinking.

The study findings demonstrated that intentionally integrating explicit critical thinking instruction with purposeful and appropriate integration of technology into a class has the potential to support the students' development of critical thinking. Designing a course with such components will help the students achieve these learning outcomes.

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