Using Peer Feedback in Online Discussions to Improve Critical Thinking

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Abstract

This study sought to evaluate the effectiveness of a peer feedback strategy in asynchronous online discussions. Specifically, this exploratory study examined the impact of peer feedback in online discussions on students' perceived and actual critical thinking skills in terms of receiving and providing peer feedback Participant interviews and pre and post surveys targeting critical thinking skills were utilized in a mixed method study approach. Results indicate that participants perceived the peer feedback strategy as having impacted their learning at a higher cognitive level. Qualitative data reveals how the peer feedback process impacted students' learning, both as receivers and providers of peer feedback. The study has implications for teaching and designing online courses that employ asynchronous discussions.

Background

The increase of online learning, including fully online and hybrid courses continues to increase with no plateau sight. In the United States alone there were nearly 3.2 million students taking at least one online course as of fall 2005 (Allen & Seaman, 2006). Within these courses online discussions and dialogue have been heralded as a potentially powerful tool that can assist students in the construction of knowledge, serve as a scaffold that allows for multiple perspectives resulting in additional knowledge, negotiation of meaning, and an understanding of knowledge gaps a learner may possess (Land, Choi & Ge, in press; Haavind, 2006; Maor, 2003; Roehler & Cantlon, 1997). This method aligns with social constructivist theories, specifically Vygotsky's social constructivist theory of learning (Driscoll, 2004). Social constructivist theory argues that learning is social in nature, suggesting that online discussions can become fruitful learning environments when they are developed in an appropriate manner. In particular, the use of online discussions can be tied to Vyogtosky's notion of the Zone of Proximal Development (ZPD), the distance between what learners can do by themselves and what they can achieve with assistance (1978).

Peer Feedback in Online Learning

Feedback, as an integral aspect of the learning process, is promoted by researchers and practitioners alike (Mory, 2004; Driscoll, 2004). In his analysis of feedback research in learning, Mory (2004) suggested that feedback is a "critical function in knowledge acquisition" (p. 777) and that without a feedback mechanism learning would not occur. Whether learners are in an online or traditional environment this holds true, and as Dunlap (2005) suggested feedback for online learners can also serve to counter feelings of disconnect or isolation while a lack of feedback can slow learners' progress. Nicol and Macfarlane-Dick (2006) suggested that feedback serves as a form of formative assessment, designed to improve and accelerate learning. Specifically, feedback is defined "… as anything that might strengthen the students' capacity to self-regulate their own performances" (p. 206).

Given this, proponents of online learning environments have several reasons to explore feedback strategies, including peer feedback. Instructor workload, for one, has been an issue discussed, though mostly anecdotally, in the literature (Dunlap, 2005; Dennen, 2003). Just as students perceive their workload increasing for online courses, so do instructors. Peer feedback has the potential to reduce an instructors' workload while simultaneously providing the type of feedback that is important to students' learning and growth.

Boud, Cohen, and Sampson (1999) explained the importance of peer learning or feedback in today's world, including employers' demands that college graduates possess a broader range of skills including the ability to communicate effectively. Specifically, they cite the need for transferable skills, key competencies, and generic attributes or competencies, all skills that foster lifelong learning. Furthermore, peer learning and lifelong learning skills both incorporate "the development of learning outcomes related to collaboration, teamwork, becoming a member of a learning community, critical enquiry and reflection, communication skills, and learning to learn" (p. 417).

Liu, Lin, Chiu and Yuan (2001) described peer learning as "valuing the exchanges of critical feedback among peers and modifying works according to peer feedback" (p. 246). They suggested that peer review or feedback can foster an authentic learning environment in which students actively construct knowledge. In their study of a web-based peer review system they described what students achieved through the peer review process: peer review allowed them to "read, compare, or question ideas, suggest modification, or even reflect how well one's own work is compared with others. While processing these cognitive functions one monitors the adequacy of their work" (p. 248). It is during this process that cognitive functions, including critical thinking, are hypothesized to increase. Correspondingly, Boud et al. (2001) expressed the idea that students learn a great deal by explaining their ideas to others and by participating in activities in which they can learn from peers.

Just as there are many advantages to using peer feedback, there are also potential challenges. The first challenge that instructors need to be aware of is that many students are not familiar with the peer assessment process, not in any formalized way; as Palloff and Pratt explain, meaningful peer assessment "is not a naturally acquired skill" (1999, p. 123). Topping, in his review of peer assessment, noted several of the more prominent challenges including: poor performers not accepting peer feedback as accurate, students refusing to take responsibility for assessing peers if they see the peer assessment as substituting for instructor feedback or if they are part of a small "socially cohesive" group, a need to monitor peer assessment for potential abuse of peer power, and a concern about issues of reliability and validity (Topping, 1998, p.256).

Teaching and Assessing Critical Thinking

There is much talk given to the concept of critical thinking and related skills in learning and instruction, and as many definitions and perspectives as there are disciplines. Facione and Facione (2007) define critical thinking as “reflective decision-making and thoughtful problem solving about what to believe and do” (p. 44). Similarly, Halpern (2003) defines critical thinking as “cognitive skills and strategies that increase the likelihood of a desired outcome. . . thinking that is purposeful, reasoned, and goal-directed—the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and make decisions” (2003, p. 6).

The many approaches to teaching critical thinking skills is parallel to the many approaches to assessing them as well. Spicer and Hanks (1995) reported on seven standardized critical thinking tests available as well as several performance assessment approaches that can be used as outcome measures within various subjects. Standardized tests can provide useful information that is diagnostic and may help to guide instruction. However, multiple measures of critical thinking should be used whenever possible, since critical thinking is not a general ability but rather a complex set of general and specific factors. For example, in addition to multiple-choice tests, open-ended assessments and interviews could be incorporated into assessments of critical thought.

Studies have shown that online discussions can support critical thinking (Gunawardena, Lowe, and Anderson, 1997; Bullen, 1997; and Jeong, 2000 as cited in Yang, 2002). Furthermore, several recent studies have reported on the assessment of critical thinking skills focusing on students engaged in online discussions. The Community of Inquiry (COI) Model is a framework that was developed to assess the nature of critical thinking, specifically higher-order thinking, in online discussions from a practical approach (Garrison, Anderson & Archer, 2001). The COI is a four phase model (triggering, exploration, integration and resolution), based on earlier work (see Garrison & Archer, 2000), that was developed by conducting a content analysis of transcripts form online discussions. The study concluded that the framework could provide instructors with a tool to asses critical thinking but also cautioned that in order to have higher order thinking there must be sustained critical discourse, one that involves the full cycle of the critical thinking process, a skilled instructor facilitation, and interaction that is both coordinated and synergistic (p. 11).

Similarly, Hemphill and Hemphill (2006) investigated the affect of virtual guest speakers in an online educational technology graduate course and the extent to which the students engaged in critical thinking within online discussions. The results indicated that higher-order thinking occurred throughout the course, and reported that their findings had implications for instructors, including monitor discussions and a "judicious use of appropriate responses by facilitators [to] maintain a high frequency and critical thinking level of responding by the students"(p. 292).

Purpose of the Study

Prior to this study, the peer feedback strategy was implemented in a graduate level technology integration course in the spring semester of 2005. Feedback from students about ease of use and perceptions of the process informed the use of peer feedback in this study (See Ertmer, Richardson, Belland, Camin, Connolly, Coutlhard, Lei & Mong, 2007). The peer feedback instructional strategy was initially envisioned as a way to provide ongoing feedback to students while decreasing instructor load in online courses. This study was designed to evaluate the effectiveness of a peer feedback strategy in asynchronous online discussions. Specifically, this study examined the impact of peer feedback in online discussions on students' perceived and actual critical thinking skills. The research questions included:

1. What were students’ perceptions of the impact of the peer feedback strategy on their learning? in terms of providing and receiving peer feedback?
2. What was the effect of peer feedback on students' critical thinking skills, as measured by a critical thinking skills test?

Methods

Given that this is an exploratory study, a mixed model research approach was utilized (Johnson & Christensen, 2004). The mixed methods research design maximizes the strengths and minimize the weaknesses associated with single-method designs, while allowing for triangulation of the data (Johnson & Onwuegbuzie, 2004; Frechtling & Sharp, 1997). Specifically, a pretest-posttest design (Gall, Borg, & Gall, 1996) was triangulated with participant interviews.

Participants. The participants included an intact group of 16 graduate students (of 19 total) enrolled in an online technology integration course during the spring semester of 2006 at a large Midwestern university. Participation in the research study was voluntary; the peer feedback process, however, was not voluntary as it was embedded within the course. Participants earned extra credit for participating in the study; an alternative extra credit option was also presented.

Participants ranged in age from 24 to 52; 8 were female, 8 were male. Twelve participants were Caucasian, 2 were African-American, 1 was Hispanic, and 1 identified him/herself as "Other." Seven participants indicated this was their first online course, 6 had taken one or two online courses including this course, and 3 had taken more than two online courses. Students indicated they spent an average of 6.5 hours per week on the online discussion portion of the class.

Context and Procedures. The researcher reporting on this exploratory study also served as the faculty member teaching the course. While the peer feedback process was embedded in the course the interview data were collected by two independent (graduate) researchers and not provided to the researcher until the close of the course and assignment of final grades.

The course, Integration and Management of Computers in Education, was an online, graduate level course. The course was co-taught by a faculty member (the researcher) and an experienced graduate assistant who had previously taken the course. Students met face-to-face (or via Internet-based video conferencing) for the first class session; all subsequent interactions occurred electronically, within a WebCT course management environment. While the course had several major projects, this study focused on the weekly discussion questions (DQs) and postings. In a typical week, students were given one or two discussion questions and expected to post at least one response to each discussion question and two responses to peer's postings for each discussion question. A total of 18 discussion questions were posted over the 15 week semester. Students were also provided with a "free pass" which allowed them to skip the discussion question(s) for one week.

The scoring rubric for the discussion questions was adapted from Ertmer and Stepich (2004), and provided the instructors and students with a concrete tool for determining the quality of thinking embedded within online postings. Prior to using the rubric for peer feedback students were exposed to modeling of feedback by the instructors and examples of possible responses, with an explanation of why each response merited a specific score (e.g. handout with examples, discussion in class). Moreover, the course instructors provided two weeks of feedback, for a total of four discussion questions. This feedback was provided as a model of the peer feedback the students would provide as the course progressed.

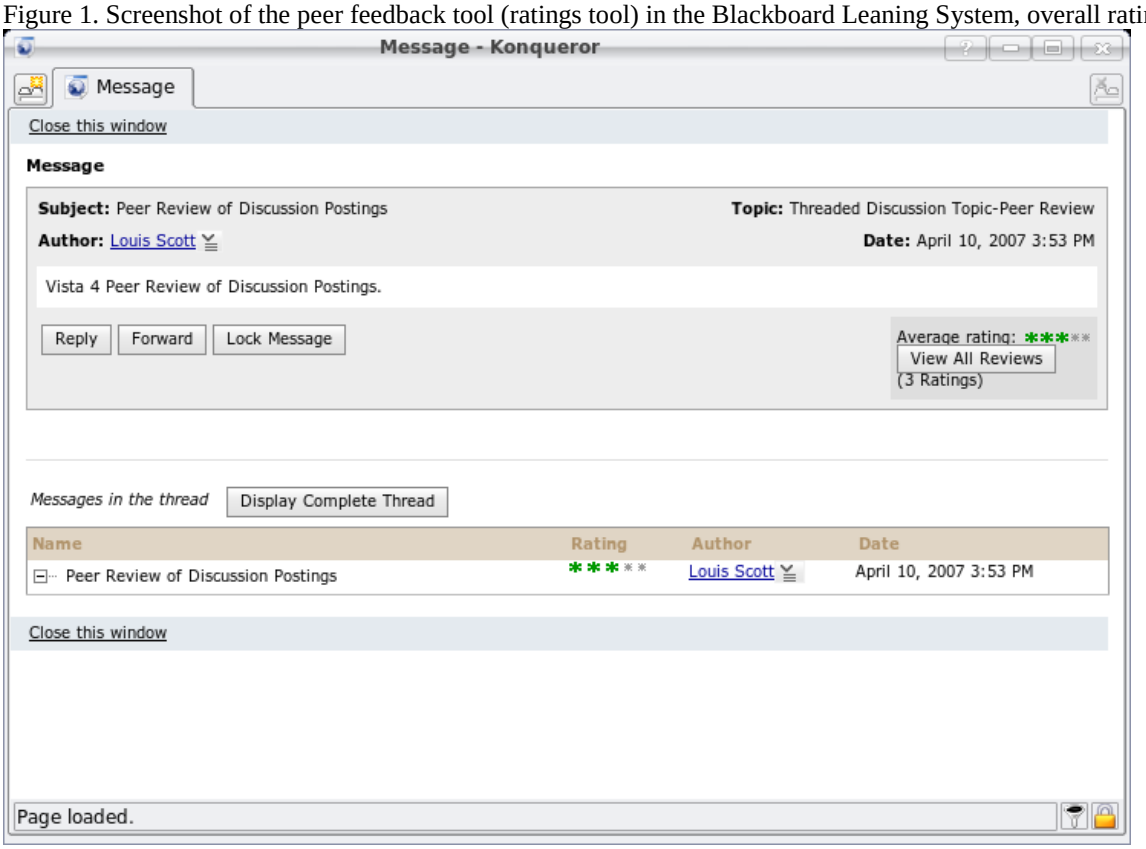
For this study, peer feedback was defined as 1) a numerical score (from 0 - 2) based on Bloom's taxonomy and 2) descriptive comments, supporting the assigned score. Postings demonstrating analysis, synthesis, or evaluation received 2 points; postings at the knowledge, comprehension, and application levels received 1 point; non-substantive comments received 0 points. The peer feedback process was set up in advance with students receiving specific guidelines, including the following:

- Peer feedback provided was confidential,
- Peer feedback assignments were randomly assigned for each DQ Students were asked to utilize the Bloom's taxonomy rubric to award points in combination with either constructive comments for improvement or a rationale for the points awarded.
- Students were awarded up to 2 points for each peer feedback response completed (8 discussion questions requiring peer feedback, two people per question at 2 points each for a total of 32 points); points could be deducted if peer feedback was not provided as assigned or in a timely manner.
- The discussion scores provided via the peer feedback process counted towards students' discussion grades; an average of the 2 scores received from peers for each DQ was calculated for an overall DQ score. Students were informed that if they felt any score or comment was unwarranted that they could protest the

feedback via the instructors (mediation process). Only five scores/comments were protested during the process.

In addition, students were provided feedback from the instructor on their use of peer feedback for the first two DQs involving the peer feedback process. The process was completed via an online survey system, and channeled through the instructors who looked over the comments and scores for any obvious discrepancies or inappropriate comments. A sample screenshot of the peer feedback tool is provided (see Figure 1).

Figure 1. Screenshot of the peer feedback tool (ratings tool) in the Blackboard Leaning System, overall ratings view.



Data Collection and Analysis

Quantitative and qualitative data were collected. Qualitative data were gathered by means of interviews conducted by two researchers, independent of the course, following the peer feedback process in the course (weeks 14 and 15). This data was not provided to the researcher/instructor until the close of the course. Interview results captured students' overall perceptions of the peer feedback process and perceived changes in critical thinking skills. Quantitative data were collected using a pre- and posttest administration of a critical thinking skills survey, the California Critical Thinking Skills Test (CCTST).

Interviews. Participant interviews (n=16) were conducted to obtain more detail about individual students' thoughts and perceptions about the peer feedback process (as well as participants' perceptions of their critical thinking and any changes they may have noticed over the course of peer feedback process. Interviews lasted 45 to 60 minutes, were recorded electronically, and then transcribed.

Following are several sample interview questions used in the study:

- What were your initial impressions of the peer feedback process?
- How prepared did you feel providing peer feedback?
- Thinking back to receiving you peer feedback, especially early on, do you see any connection between the peer feedback you received and your posts?"
- When planning your posts, did you consider previous feedback you received? Previous feedback you provided to others?

- Do you feel that the peer feedback process, especially the reflective portion when you are providing peer feedback to your peers, impacted how you thought about your responses and/or the material?

The interview data were analyzed using a coding schema that was derived from the broad interview questions. After each interview was coded a search was conducted for recurring themes across interviews using NUD*IST qualitative data analysis software (Miles & Huberman, 1994). General coded categories, and thus themes, included but were not limited to the impact of peer feedback on posts, impact of peer feedback on reflective process, experiences with giving peer feedback experiences receiving peer feedback, students' perceptions of their preparedness to provide peer feedback (from the criteria provided and from modeling by the instructor), students' experiences compared to previous experiences with peer feedback, and recommendations for improvement of the process.

Pre-Post Critical Thinking Skills Survey. The California Critical Thinking Skills Test (Form 2000) was used to measure students' critical thinking skills prior to the online discussions and at the end of the course. The CCTST is based on the American Philosophical Association's Delphi consensus conceptualization of critical thinking (Facione, Facione, Blohm & Giancarlo, 2002, p. 1) and is designed to measure the skills dimension of critical thinking, with critical thinking being composed of the "disposition to think critically as well as have the skills to do so" (Facione, et al, p. 2). The CCTST measures the core reasoning skills of analysis, inference, evaluation, deductive reasoning and inductive reasoning.

The test is designed for college undergraduate and graduate level uses, from freshman year on. The CCTST survey contains 34 items and the questions provide the content to which one's reasoning skills are applied (Facione, 1990, 1992). The data were analyzed using a paired sample t-test for each of five subtests (induction, deduction, analysis, inference, and evaluation) and the total score. Mean scores and t-test results are provided in the Results section.

Validity and Reliability Issues

The California Critical Thinking Skills Test (Form 2000) is an updated version of the California Critical Thinking Skills Test Form A. Form A has been well established in terms of both its reliability and validity. (e.g. Kuder-Richardson 20 estimates of internal consistency ranging from .68 to .70; see Facione, P.A., 1990 for further details). Form 2000 retains 22 items from Form A in addition to 12 new items. A correlational study was conducted between Form A and Form 2000 with a result of r=0.912, indicating a strong reliability for Form 2000. Moreover, the developers indicate that internal consistency measures provided evidence that Form 2000 was slightly more reliable than Form A (Facione, et. al., p. 16). Finally, Content and construct validity for the CCTST Form 2000 is provided by the development of the instrument from the APA's Delphi study (Facione, e. al., p. 18)

Validity concerns were addressed, primarily, through the triangulation of data sources. For example, interview results provided perceptions of changes in student learning or critical thinking skills while the California Critical Thinking Skills Test (Form 2000) pre-post critical thinking skills survey provided researchers with standardized critical thinking scores. The interviews also provided opportunities for participants to elaborate on the ideas being explored and provide more detailed explanations. The interviews were transcribed verbatim and were member-checked to ensure accuracy.

Results

Participants' Perceptions of Impacts on their Learning

The first research question relates to participants' perceptions about their learning in relation to the peer feedback strategy. During the interviews all participants (n=16) discussed their learning and possible changes in learning (e.g. critical thinking skills) during the peer feedback process. Specifically, participants were asked about (1) their learning in terms of the impact the peer feedback process had on their discussion posts (n=14), and (2) how the reflective portion of the process, which occurred as they prepared the feedback for their peers, impacted their learning or critical thinking processes (n=14).

The majority of respondents (n=10) explained that the peer feedback they received impacted their postings. For example, one participant stated, "One time someone gave me feedback that I was not incorporating the readings, because I didn't…so as I read the articles I'd highlight something and say 'OK, I'm going to include this in my postings'" (Participant 7, lines 267-272). Similarly, another participant explained

> I would always take the peer feedback into consideration in my next [posting]. If there was something that they commented on that was lacking, I would definitely try to make up for it in the next discussion, or try to

> be more aware of it, and go back to the rubric and say "OK, what am I missing here?" And if there's things they liked I definitely… would do that more (Participant 1, lines 121-127).

Moreover, several participants (n=4) discussed the idea that the peer feedback they received impacted how they conceptualized their postings, more specifically they discussed the perceived relationship between peer feedback and improved critical thinking, mirroring the first example.

> I think in some ways [the peer feedback process] made me think about what I was posting and how much I was posting…and how someone else would perceive my postings. Early on I think my postings were less in-depth. After a while I started to think about the topic more in depth before I actually posted…I found myself posting less but posting more significantly (Participant 4, lines 91-97).

Participants were also asked specifically about the reflective portion of the process, as described in a previous study by Ertmer, et. al. (2007). The reflective portion takes place as peers develop and provide feedback and is the part of the process that students in the previous study indicated had the most impact on their learning. Of the 14 participants who responded to this topic, the majority (n=10) indicated it did impact their learning, 2 did not see any connection between the process and their learning, and 2 were unsure of a connection. Of the participants who described a connection between providing peer feedback and their own learning, their examples varied from awareness to critical analysis. While the awareness of the process can prove to be an invaluable indirect connection to learning, the participants who spoke of engaging in more critical analysis of their work provide a more direct connection. For example, as one participant explained,

> I started to think about why I was assigning the grade that I did to someone's postings, and I got to thinking, 'They're going through the same process', so I think it made me more aware of what I needed in mine to make sure I received the kind of grade I wanted to receive...It made me think more carefully about my own posts (Participant 8, lines 157-164).

Along these lines several participants (n=6) described a sense of awareness mixed with critical analysis of their own postings, as exemplified by the following,

> I think that by doing [the peer feedback] it improved my own discussion and what I was contributing to the class because I knew better what was required and what would help the discussion. And, I [paid attention] to what others were using, what was working, and I told them in their feedback, and then I tried to implement that more in my own discussions…I guess it made me more critical of my own discussion [postings]. It made me more aware of other avenues I could take…by doing the peer feedback it enhanced my own discussions (Participant 1, lines 59-63, lines 146-150).

Overall all participants indicated that the peer feedback impacted their posts either through the reception or provision of feedback, and ranging from an awareness level to a higher cognitive level. In general, participants who described reaching "awareness" of the impact referred, primarily, to receiving peer feedback while the majority of participants describing changes at higher levels referred, primarily, to giving peer feedback.

Participants' Learning as Measured by the California Critical Thinking Skills Survey (CCTST)

The second research question examined changes in students' critical thinking skills after implementation of the peer feedback strategy, as measured by the California Critical Thinking Skills Test (CCTST) (Form 2000). The CCTST data were analyzed utilizing the null hypothesis that *there is no significant difference between the means of the two variables*, or in this case the pre and post CCTST scores.

Table 1
Paired Samples Statistics (n=16)

	Pre-Test			Post-Test		
	Mean	Std. Deviation	Std. Error Mean	Mean	Std. Deviation	Std. Error Mean
Induction	10.50	2.58	.65	9.75	2.96	.74
Deduction	8.38	2.50	.63	9.25	3.38	.84
Analysis	4.56	1.63	.41	4.19	1.17	.29
Inference	9.13	2.06	.52	9.31	3.34	.84
Evaluation	5.19	2.23	.56	5.50	1.86	.47
Total Score	18.88	4.49	1.12	19.00	5.67	1.42

The average mean for each pre and post test across the 5 subtests (induction, deduction, analysis, inference, and evaluation) and the means for the total scores for the pre and post test are provided in Table 1. The average mean increased for the deduction, inference, and evaluation subtests as well as total score.

Table 2
Paired Samples T-Test Results

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pre-Induction – Post-Induction	.750	2.543	.636	-.605	2.105	1.18	15	.256
Pre-Deduction – Post-Deduction	-.875	2.918	.730	-2.430	.680	-1.20	15	.249
Pre-Analysis – Post-Analysis	.375	1.962	.491	-.671	1.421	.764	15	.456
Pre-Inference – Post-Inference	-.188	2.613	.653	-1.580	1.205	-.287	15	.778
Pre-Evaluation – Post-Evaluation	-.313	1.991	.498	-1.373	.748	-.628	15	.539
Pre-Total – Post-Total	-.125	4.617	1.154	-2.585	2.335	-.108	15	.915

As Table 2 demonstrates, a paired-samples t-test revealed no significant differences in the subtest scores prior to the peer feedback process and following the process. Since the probability is greater than .05, we accept the null hypothesis of no difference. Several reasons could account for the lack of any statistically significant findings of the CCTST, including limited time of the peer feedback intervention (approximately seven weeks), and the limited sample size. However, a more likely reason is that the CCTST is not a good measure of the critical thinking being promoted by the online discussions.

Discussion

The peer feedback process described in this study served to assist students in their learning process, allowing for opportunities to engage in higher level thinking (Liu, Lin, Chiu, & Yuan, 2001). For example, in this study several of the participants perceived the peer feedback as having impacted their learning at a higher cognitive level, such as their critical thinking skills. In their interviews participants discussed how the peer feedback process impacted their learning, both as receivers and providers of peer feedback; the deeper impacts appear to have occurred during the reflective process of providing peer feedback.

While the critical thinking skills test (CCTST) did not demonstrate significant increases after the peer feedback process, participants' scores did not decrease, they appeared to have plateaued. The CCTST was chosen to measure actual outcomes for this study because the categories of the critical thinking skills being tested (analysis, inference, evaluation, deductive reasoning and inductive reasoning) appeared to align with Bloom's taxonomy (evaluation, synthesis, analysis, application, comprehension, and knowledge) on which the course was basing the ratings of the online discussions. However, as previously discussed in the review of literature, there are many definitions and measures of critical thinking, which leads the researcher to believe that perhaps the CCTST is not a good measure of the critical thinking being promoted by the online discussions. Given this, even if overall critical thinking is, as Halpern (2003) defines, the "cognitive skills and strategies that increase the likelihood of a desired outcome. . . thinking that is purposeful, reasoned, and goal-directed—the kind of thinking involved in solving problems, formulating inferences, calculating likelihoods, and make decisions" (2003, p. 6), then perhaps we as researchers need to look to more course or content specific measures. At the very least we should look to the Community of Inquiry model (Garrison, et. al., 2001) as it goes beyond a performance assessment and looks to the

unique environment that online discussions create. And as good researchers often do when considering a variable as complex and broad as critical thinking, we should use multiple measures to help us better understand and target the variable being researched (Spicer & Hanks, 1995). Indeed, perhaps there is a need for a new measure that targets what the students' perceive as having occurred in terms of their learning.

Future Research

The peer feedback process was originally conceived of as a way to provide ongoing feedback and reduce instructor load, this study only examined the implementation of the peer feedback strategy while future research will include an examination of instructor load. Moreover, keeping in mind that this is an exploratory study, and thus the small number of participants, the researcher and her colleagues are currently implementing the research on a larger scale with undergraduates in education and engineering. A power analysis has identified a minimum number of 98 students as being necessary in order to obtain a medium linear relationship (e.g. .25) at the .05 level of significance while holding that .70 is a reasonable level of power for producing a statistically significant finding (Keppel et al., 1992). In addition, the researcher and her colleagues are looking into the use of a different standardized measure of critical thinking that may align better with the types of critical thinking promoted in online discussions.

Finally, research is currently being conducted on the impact of the peer feedback process as it relates to social presence (Gunawardena & Zittle, 1997). Specifically, the researcher is examining students' perceptions of the peer feedback process and whether they felt more connected to the learning community (e.g. peers) as a result of this process. Social presence, which has been shown to have an impact on students' perceived learning and satisfaction, is an important research area that speaks to the complexities of online learning (Richardson & Swan, 2003).

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