ENHANCING COLLABORATIVE LEARNING: IMPACT OF *QUESTION PROMPTS* DESIGN FOR ONLINE DISCUSSION

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Abstract

Objective: *The purpose of study was to investigate the impact of* question prompts *designed to guide students' focus on context-related issues as they solve problems in a web-based environment.* ***Background:*** *Online discussions integrated with collaborative learning were used to examine student interactions and behaviors in an online discussion.* ***Method:*** *Twenty graduate students were randomly assigned to either the treatment (ten participants) or the control group (ten participants); one group received* question prompts *while working in the web-based learning environment while the other did not. At the end, they were asked to fill out an online questionnaire rating their confidence and competence levels in the problem solving process. Analyses were conducted to determine the impact of* question prompts. ***Results:*** *Statistical results showed that students who received* question prompts *from the instructor received significantly higher evaluations than students who did not receive* question prompts *when analyzed overall and when each rubric was analyzed individually. In addition, the study also suggested that online discussion had significant positive impact in developing students' deeper learning.* ***Conclusion:*** Question prompts *designed by the instructor helped to enhance students' self-efficacy about their ability to solve complex problems.* ***Application:*** *The outcome indicated the importance of teachers' guidance and assistance to lead students into deeper learning. Although online learning provides flexibility and potential for deeper learning, the online discussion needs to be structured and moderated throughout the process.*

Deeper learning engages the learners who actively explore, reflect, and produce knowledge (Wickersham & McGee, 2008), and it has been gaining popularity over the past decade. Although current discourse and literature tends to encourage deeper learning as a desired outcome (Carmean & Haefner, 2002) what actually happens when online discussion tools are used may not reflect these principles. This disparity may be deeper than what researchers observe in actual practice. Embedding deeper learning theory into online discussion design by actively engaging the learners, providing them ownership of knowledge they have produced can only ensure that learning transcends the classroom. In order for deeper learning principles to be applied to online collaborative discussions, teachers must consciously consider the entire learning environment and how they

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articulate the processes within that environment. For example, Laurillard and McAndrew (2003) propose the design of generic learning activities that shifts teaching from a transmission model to a construction model. Their conversational framework is an iterative process that requires learners to engage, act, and reflect upon what they know and how they come to learn through the effectiveness of discussion in a web-based learning environment.

There has been prolonged discussion about deficiencies in students' abilities to establish a higher order thinking base resulting from oversimplifying complex new knowledge and generating vague relationships between prior and new knowledge (Feltovich, Spiro, Coulson, & Feltovich, 1996). Students often process information superficially and mindlessly (Bransford, Brown, & Cocking, 2000). Lack of knowledge integration hinders knowledge acquisition and further impairs abilities to solve real-world problems. Deeper understanding is crucial because it stimulates awareness and capacity for monitoring, active reflecting, evaluating, and modifying one's own knowledge (Linn & Hsi, 2000).

Collaborative discussions have the potential to enhance individualized learning experiences for learners in which their learning styles, prior knowledge, and specific learning needs are taken into account. Group discussions have been demonstrated to have a positive impact on learning by facilitating collaborative thinking and better understanding (Levin, 1995), and by raising self-efficacy through observing peer models (Brown & Inouye, 1978; Schunk, 1987). However, studies by Carrier and Sales (1987), and Werner and Klein (1999) found no significant differences in learning achievement between students working in groups and students working individually.

Online courses integrated with online collaborative learning represent a new and greatly valued opportunity, not only in terms of access to fellow students but also in the chance to work together (Macdonald, 2003). It is important to construct the asynchronous discussions in an attempt to provide a basis for critical discussions and critical thinking. Faculty can use group projects and discussions to engage students in a cooperative and/or collaborative learning environment. Group work can provide students opportunities to have deeper analysis of topics, to reflect on their learning discovering different approaches to tasks, and to discover points they missed in their preparation for the discussion. It is not uncommon to find that students post discrete and superficial messages that are not indicative of engagement nor in-depth thinking that lead to meaningful knowledge construction. Therefore, this study was conducted to examine student interactions and behaviors in an online discussion to enhance their online collaborative learning by investigating the impact of *question prompts* designed to guide students' problem solving skills in a web-based environment.

Literature Review

Group work can promote student critical thinking skills, problem solving skills, and social skills (as cited in Wang, 2010). Brown, Collins, and Duguid

(1989) assert that students need to be able to work with and listen to others, and to develop ways of dealing with complex issues and problems that require different kinds of expertise. To bring out expected learning outcomes, the instructor needs to respect each person's contribution, and the community as a whole should be able to synthesize diverse views (Bielaczyc & Collins, 1999). An emphasis on collaboration, as an essential element of this process, can strengthen group processing skills, subsequently enhancing citizenship in a diverse democracy (Cohen 2001; Dewey, 1902/1966). Within this framework, knowledge cannot simply be transmitted from teacher to student or individual to individual. Instead, knowledge is developed through the synthesis of social experiences transpiring in the classroom. In other words, the goal of the collaborative learning is not merely "knowledge acquisition" and "participation," (Doolittle, 2001; Sfard, 1998), but "knowledge building" focusing on knowledge creation (Paavola, Lipponen, & Hakkarainen, 2004).

Numerous studies have shown that learning through collaboration, as compared to competitive or individual learning, usually results in higher achievement, better psychological connections (caring, support, and commitment), greater psychological health, social competence, and self-esteem (Johnson & Johnson, 1989; Johnson, Johnson, & Smith, 1991; Smith, 1995). It has been also argued that incorporating well-planned collaborative activities benefits teachers as well as their students, since higher order thinking skills are more likely to be generated (Schultz, 2003) and impact the learning process by improving socialization skills as well as enhancing critical thinking (Jegede, 2002). Other benefits of online collaboration that have been cited include reflection, peer feedback (Ruhleder & Michael, 2000), and the reduction of anxieties in social situations (Gokhale, 1995).

However, simply assigning students into a group and asking them to work collaboratively will not guarantee that they will collaborate (Kreijns, Kirschner, & Jochems, 2003). Therefore, numerous studies attempted to further identify some critical element associated with online collaborative learning. For example, Thompson and Ku (2006, 2010) generalized four critical attributes of the discussion patterns within an online collaborative group from the literature: 1) Participation, 2) Interdependence, 3) Synthesis of information, and 4) Independence. Curtis and Lawson (2001) characterized five behaviors categories associated with collaborative learning based on Johnson and Johnson's model (1996). They are: 1) Planning (e.g., group skills, organizing work, and initiating activities), 2) Contributing (e.g., help giving, feedback giving, exchanging resources and information, sharing knowledge, challenging others, and explaining or elaborating), 3) Seeking input (e.g., help seeking, feedback seeking, and advocating effort), 4) Reflection/Monitoring (e.g., monitoring group effort and reflecting on medium), and 5) Social interaction. Johnson and Johnson (2004) specify five basic elements needed for effective group collaboration: 1) Positive interdependence, 2) Promotive interaction, 3) Individual accountability, 4)

Appropriate use of social skills, and 5) Group processing. According to Johnson and Johnson (2004), positive interdependence, which is the heart of effective collaboration, transpires when each member in a group perceives that he or she cannot succeed unless the group does. Another element for effective collaboration is promotive interaction, which exists when group members act as trustworthy members by acknowledging and challenging one another's ideas and facilitating one another's efforts. To ensure each member's active participation in a group project, teachers must assure individual accountability. This can be achieved when each group member's performance is assessed. Using collaborative learning necessitates group members to have social skills for trust building within the team, clear communication, and constructive conflict resolution. Group processing includes monitoring all members' work to ensure the quality of the work, facilitate social interaction, and ensure reciprocal interaction so that group members can collaborate effectively.

With the advent of the Internet and communicative media, there have also been many attempts to incorporate collaborative learning methods in online environments. Hiltz and Turoff (2002) suggest that collaborative learning activities which are well-suited for online environments include debates, group projects, case study discussions, simulations, role-playing exercises, the sharing of solutions for homework problems, and the collaborative composition of essays, stories and research plans. However, in reality, most online collaborative work is usually relegated to discussion board conversations, in which students merely generate a dialogue with their peers about the weekly readings. While this type of activity can certainly be useful, the extent of actual collaboration is usually quite limited. Similarly, there have also been more critical views taken by several researchers. Dirkx and Smith (2004) found that learners are often reluctant, frustrated and dissatisfied with collaborative learning methods, especially when working within small online groups, because they "struggle with the development of a sense of interdependence and intersubjectivity within their online groups, but end up holding fast to subjective, individualistic conceptions of learning" (p.134).

Research Questions

In order to examine the quality of students' online learning, the researchers developed rubrics in three general areas to guide the study: (a) students' ability to identify the problem, (b) students' ability to develop a needs assessment, and (c) students' ability to construct and link the problem and the need into a clear and rational problem and to complete a needs assessment. The following questions were used to guide the study:

1. Were students able to identify the problem from the case study provided?

   Students' ability was measured in four specific areas:

   • Ability to determine if a need exists

- Ability to analyze the problem: cognition (learning style), perception (motivation), and instrumental (external tasks)
- Ability to interact with instructor: cognition, perception, and instrumental
- Ability to identify needed resources : cognition, perception, and instrumental

2. Were students able to develop a needs assessment plan?

   Student's ability was measure in three areas:

   - Ability to generate a hypothesis.
   - Ability to identify the data type and analyses required
   - Ability to identify the data sources

3. Were students able to construct an argument and present a rationale?

   Student's ability was measured in three areas:

   - Ability to link the problem, the needs analysis, students, instructor, and resources.
   - Ability to develop alternative solutions
   - Ability to develop and complete the needs assessment

Research Design

The purpose of this study was to investigate the impact of *question prompts* designed to guide students' focus on context-related issues as they solve problems in a web-based environment. This case study involved online discussions with problem-solving strategies. The participants were randomly assigned to either the treatment or the control group, either receiving or not receiving discussion questions while working in the web-based learning environment.

Participants

The participants in the study were twenty graduate students enrolled in an instructional technology (IT) course at a major southern university. Ten students were randomly assigned to the control group and completed problem solving activities without instructor's *question prompts.* Another ten students were in the treatment group and received the additional *question prompts*.

Both groups had to complete Case Study 1 (pretest) by writing a solution report to address the problem without being prompted. Following the pretest, the participants were directed to Case Study 2 (posttest). During this activity, the treatment group received a list of *question prompts* for discussion after finishing reading the case study while the control group did not receive the prompts. However, the control group was simply asked to analyze the problem in response

to Case Study 2, write and submit a solution report. At the end of the study session, all the participants were asked to fill out an online questionnaire rating their confidence and competence levels in solving real-world problem before and after the study.

Instructional Materials

In order to promote higher-level thinking and problem-solving ability, the instructor gave the students the case study to diagnose, analyze and discuss. Both Case Study 1 and Case Study 2 were authentic, ill-defined instructional design problems on needs analysis and shared the same underlying structure and tasks. The participants were asked to play the role of an instructional design consultant to provide suggestions or solutions to the character (e.g., a professor) involved in the case study.

Procedures

The discussion questions were designed to provide students step-by-step procedural guidance in completing the case study, in addition they also served to prompt them to elaborate their thinking, articulate their thoughts, make justifications for their decisions and solutions, and monitor and evaluate their reasoning and problem solving processes.

> Rubrics were developed to evaluate students' needs assessment reports, and written records generated by the course management system for each student were provided to independent evaluators who rated the quality of students' work using an instrument based on the rubrics that guided the study. They were categorized into 3 areas: (a) representing the problem, (b) developing needs assessment plans, and (c) constructing argument respectively. Each report was evaluated by the same two raters (IT professors), and the major differences of the scores were discussed until a consensus was reached. A week later, the independent evaluators again rated the quality of the students' work and the scores from both evaluations were correlated to justify the reliability of the rating process, $r = .82$, $p. \leq .05$.

Limitations of the Study

The study involved twenty students who were enrolled in a web-based course in the fall semester of 2008. All students volunteered to participate in the study, and no attempt should be made to generalize the findings beyond these groups. Students' interaction in the web-based classes was evaluated by analyzing the written documentation available from the course: chat rooms, email, bulletin boards, and completed assignments.

Research Findings

Question 1 - Problem Representation

Question 1 was: Were students able to identify the problem from the case study provided?

In the area of problem representation, students were required to determine if a problem existed from a case situation provided to them via an online course, and then to analyze the problem and to interact with the instructor in order to demonstrate their ability to analyze the case situation (cognition), to demonstrate their cognitive ability to analyze the situation and to proceed to the next step in the process, and to perform the necessary external tasks required such as reviewing and/or researching the steps required for a "needs assessment." The evaluators rated the three areas that made up the Problem Representation rubric. A maximum of 11 points could be awarded in this area based on the quality of the students' interaction and submissions.

As shown in Tables 1 and 2, the scores for the control group in the area of Problem Representation ranged from 2 to 8, with a mean score of 5.9. The scores for the experimental group ranged from 5 to 11, with a mean of 7.8. A t test was used to determine if the total scores for the two groups in the problem representation area were significantly different. As shown in Table 3, the groups were significantly different with the experimental group receiving significantly higher scores in the Problem Representation area at the p. $\leq$ .05 level.

Table 1

Problem Representation Control Group

Mean	5.90
Median	6.00
Mode	5.00
Standard Deviation	1.79
Sample Variance	3.21
Range	6
Minimum	2
Maximum	8
N	10

Table 2

Problem Representation Experimental Group

Mean	7.80
Median	8.00
Mode	8.00
Standard Deviation	1.62
Sample Variance	2.62
Range	6
Minimum	5
Maximum	11
N	10

Table 3

t text Problem Representation

Group	Mean	S^2	t	p.
Control	5.9	3.21	2.49	≤.05
Experimental	7.8	2.62		

Question 2 - Needs Assessment

Question 2 was: Were students able to develop a needs assessment plan?

In the area of Needs Assessment the students were required to develop a hypothesis based on the problem representation, to determine types and measuring methods to be used, and to identify data sources. The evaluators rated the three areas that made up the Needs Assessment rubric. A maximum of 8 points could be awarded in this area based on the quality of the students' interaction and submissions. As shown in Tables 4 and 5, the scores for the control group in the area of Problem Representation ranged from 1 to 5, with a mean score of 3.3. The scores for the experimental group ranged from 3 to 7, with a mean of 5.5. A t test was used to determine if the total scores for the two groups in the Needs Assessment area were significantly different. As shown in Table 6, the groups were significantly different with the experimental group receiving significantly higher scores in the Needs Assessment area at the level p. ≤ .05.

Table 4

Needs Assessment Control Group

Mean	3.30
Median	3.00
Mode	3.00
Standard Deviation	1.06
Sample Variance	1.12
Range	4
Minimum	1
Maximum	5
N	10

Table 5

Needs Assessment Experimental Group

Mean	5.5
Median	5.5
Mode	7
Standard Deviation	1.581139
Sample Variance	2.5
Range	4
Minimum	3
Maximum	7
N	10

Table 6

t text Needs Assessment

Group	Mean	S^2	t	p.
Control	3.3	1.12	3.66	≤.05
Experimental	5.5	2.5		

Question 3 – Argument Construction

Question 3 was: Were students able to construct an argument and present a rationale?

In the area of Argument Construction the students were required to link the various elements of the problem identified, to develop alternative solutions, and to develop and complete a needs assessment. The evaluators rated the three areas that made up the Argument Construction rubric. A maximum of 9 points could be awarded in this area based on the quality of the students' interaction and submissions. As shown in Tables 7 and 8, the scores for the control group in the area of Argument Construction ranged from 0 to 6, with a mean score of 3.0. The scores for the experimental group ranged from 3 to 9, with a mean of 6.4. A t test was used to determine if the total scores for the two groups in the Argument Construction area were significantly different. As shown in Table 9, the groups were significantly different with the experimental group receiving significantly higher scores in the Argument Construction area at the level of p. $\leq .05$.

Table 7

Argument Construction Control Group

Mean	3.00
Median	3.00
Mode	3.00
Standard Deviation	1.41
Sample Variance	2.00
Range	6
Minimum	0
Maximum	6
N	10

Table 8

Argument Construction Experimental Group

Mean	6.40
Median	6.00
Mode	6.00
Standard Deviation	2.17
Sample Variance	4.71
Range	6
Minimum	3
Maximum	9
N	10

Table 9
t text Argument Construction

Group	Mean	S^2	t	p.
Control	3	2	4.15	≤.05
Experimental	6.4	4.71		

Discussion and Implication

Collaborative learning refers to methodologies and environments in which students engage in a common and authentic task where all students depend on and are accountable to on another (Rahman, 2009). In order to evaluate the impact of online collaborative learning, the researchers studied the impact of *question prompts* designed to guide students' focus on context-related issues as they solve problems in a web-based environment.

The quality of an online discussion is affected by the design of the interaction mechanism (Gilbert & Dabbagh, 2005). During online discussion activities, applying an appropriate method of guidance is the key to in-depth learning (Hou, 2011). In this quasi-experiment, the researchers used a *question prompt* design as an instructional strategy during online discussion activities. The findings of this study revealed that students who received *question prompts* from the instructor during a web-based class received significantly higher evaluations than students who did not receive *question prompts* when analyzed overall and when each rubric was analyzed individually. For these students, the instruction of online discussion was found to play a positive role in developing students' learning, and this instructional technique seemed to have a positive impact.

Many studies discussed the issues of teachers' guidance in online discussion activities (Mazzolini & Maddison, 2007; Ravenscroft, 2007). Gilbert and Dabbagh (2005) also pointed out structuring online discussions to engage students in meaningful discourse would be a major challenge facing the instructor in web-based or online learning environments. The findings of this study indicated that teachers' guided instruction in a web-based collaborative learning environment had a positive impact on students' performance. Online instructors are encouraged to try this technique to help students achieve effective learning performance in the web-based learning environments.

Conclusion

The benefits of online collaborative learning have been widely studied, including achieving complex and higher-level concepts and skills, and bringing about different perspectives and explanations (as cited in Thompson & Ku, 2006). Thompson and Ku (2006) pointed out much of the research in this area has focused on strategies for promoting collaboration and communication at a distance using various technologies, but has not specifically focused on the group work as an

instructional strategy. Therefore, the purpose of this study was to investigate the impact of *question prompts* design on students' online collaborative learning in an instructional technology course.

Due to the small number of participants and the length of the study, the findings should be extrapolated from this study to other groups. The topic needs to be further explored and researched; however, the results of this study revealed the importance of teachers' guidance and assistance to lead students into deeper learning, instead of directly asking students to collaborate and learn with peers. Online discussions need to allow group members to bring their knowledge, abilities, backgrounds, and experiences to the group process as they construct new knowledge. Although online learning provides flexibility and potential for deeper learning, online discussion needs to be structured and moderated throughout the process. Online instructors need to have a more systematic understanding of the pedagogical problem-solving approaches to online learning with group collaborative learning. This study provides suggestions to instructors for using question prompts in web-based learning, online collaborative learning, and online problem-solving to facilitate students' deeper learning.

Credit: This study is sponsored by the DPE Research Foundation.

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