Journal of Interactive Online Learning **Volume 3, Number 3, Winter 2005**
www.ncolr.org **ISSN: 1541-4914**

The Effects of Facilitation on Cognitive Restructuring in Online Discussion

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Abstract

This study compared the effects of system-initiated (low-level) facilitation with that of facilitator-initiated plus system-initiated (high-level) facilitation on cognitive restructuring and learning achievement. Graduate students participated in facilitated online discussion within a web course for one semester. This study found no significant effects by employing an online facilitator to provide extra facilitation in addition to the system-initiated facilitation. This finding suggests that well-designed system-initiated facilitation in cognitive restructuring may be sufficient for effective online learning. This study also found a significant correlation between cognitive restructuring and learning achievement, which confirms the importance of facilitating cognitive restructuring for effective online learning (Ausubel, 1963a, 1963b; Piaget, 1980; Vygotsky, 1978). This finding suggests that creating online interaction for facilitating cognitive restructuring should be incorporated into online pedagogy for optimizing online learning effectiveness.

Introduction

Online learning has grown rapidly in higher education (Dillon & Gabbard, 1998; Koedinger, Anderson, Hadley, & Mark, 1997; Lewis, Farris, Snow, & Levin, 1999). The total number of online college students in the United States grew from 0.75 million in 1994-1995 to 1.9 million in 2002-2003 (Allen & Seaman, 2003; Olgren, 2000). Along with the rapid growth of online learning, researchers have expressed their concerns regarding the need of facilitation for effective online learning (Leem, 2002; Lewis et al., 1999; Northrup, 2002).

Online facilitation is an important factor for effective online learning from both students' and researchers' perspectives (Chang, 2004a; Gibson, 1998; Hmelo, Guzdial, & Turns, 1998; Northrup, 2002) and has been implemented in most online learning systems (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003; Grasel, Fischer, & Mandl, 2001; Slotta & Linn, 2000). The most common type of online facilitation is on-demand help that responds to students' requests for help (Aleven & Koedinger, 2000; Grasel et al., 2001; Shute & Gluck, 1996; Slotta & Linn, 2000). However, this type of help depends entirely on student-initiated request for help, which may become an obstacle to the effectiveness of online learning, especially for less-able students who may not be aware of the need for help or how to initiate a request for help (Aleven et al., 2003). As a result, students did not use on-demand facilitation effectively or even ignore it, although it is believed that on-demand help is useful when used appropriately (Aleven et al., 2003; Brush & Saye, 2002; Renkl, 2002; Wood & Wood, 1999).

The effectiveness of online facilitation on learning achievement may become clearer when an online facilitator, instead of a student, initiates more facilitation. The online facilitator can overcome the obstacles of relying on students' initiatives to request for on-demand help. Facilitation initiated by online facilitators can increase online interactions, provide extra helps to

meet student needs, and, the most important, stimulate cognitive restructuring while students are constructing new knowledge (Chang, 2004a, 2004b). Facilitating cognitive information processes, such as storyboard scaffolding process, is perceived highly associated with better learning outcomes (Brush & Saye, 2002). Also, facilitating cognitive restructuring can enable students to develop a personal meaning of learning materials for enhancing learning achievement considerably (Ausubel, 1963a, 1963b; Piaget, 1980; Vygotsky, 1978). However, there are no known empirical studies revealed the influence of facilitator-initiated facilitation on cognitive restructuring. In this study the effects of system-initiated (low-level) facilitation is compared with that of facilitator-initiated plus system-initiated (high-level) facilitation to discover its impact on cognitive restructuring and learning achievement.

Theoretical Background

This section reviews previous studies concerning cognitive restructuring, collaborative learning from cognitive perspective, and online facilitation. Then, the purpose and significance of the study is described.

Cognitive Restructuring

The following presents the definitions of cognitive structure and cognitive restructuring. Then, it discusses the approaches for developing cognitive restructuring through instructional activities. It also describes how collaborative learning supports cognitive restructuring in previous studies.

Cognitive Structure. Cognitive structure is a learner's overall memorial structure or integrated body of knowledge, which is made up of sets of concepts and ideas that are organized hierarchically and by themes (Ausubel, 1963a). Cognitive structure is also known as structural knowledge, which is the pattern of relationships among concepts in memory (Preece, 1976).

Learners' cognitive structures determine how they interact with the learning materials and environments (Jonassen, Beissner, & Yacci, 1993). It is believed that transferability of learned knowledge and skills largely depended on the adequacy of existing cognitive structure. In this light, cognitive structure is viewed as an overall framework into which new knowledge is integrated (Driscoll, 2000).

Cognitive Restructuring. Cognitive restructuring is the heart of educative process that influences the existing cognitive structure for maximizing meaningful learning(Ausubel, 1963b). Cognitive restructuring generates meaningfulness by building insightful relationships among learning materials, providing anchorage for new materials, and constituting the most orderly, efficient, and stable way of retaining it for future availability (Ausubel, 1963a).

Development of Cognitive Restructuring. Instructional activities can facilitate the development of cognitive restructuring, such as learning by teaching, scaffolding, reciprocal teaching, and online discussion. Students in the teaching condition perform better than students in the no-teaching condition, because preparing to teach someone else could produce a more highly organized cognitive structure than only trying to learn the material for oneself (Bargh & Schul, 1980). The teaching process may have caused the "teacher" to cognitively restructure or clarify material on the spot because teaching allowed the "teacher" to view the issue from a new perspective and enabled him or her to see previously unseen new relationships among the elements. Computer-based instructional scaffolds were found useful in supporting articulation, reflection, and revision of explanations and interacting effects (Brush & Saye, 2002; Carr, Gardner, Odell, Munsch, & Wilson, 2003; Land & Zembal-Saul, 2003). Reciprocal feedback from teachers was reported as an effective learning activity for cognitive restructuring (Palincsar

& Brown, 1984). And online discussion can facilitate cognitive development for adult learners (Cecil & Winking, 2004).

Collaborative Learning and Cognitive Restructuring. Collaborative learning that encompasses group activities is especially helpful in supporting cognitive restructuring. Group activities create situations for group members to process, weigh, and reformulate information and augments presented by other members, which is crucial for internalizing concepts that contribute to learning achievement (Myers & Lamm, 1976). Cognitive restructuring stimulated within a learning group encourages reshaping ideas and learning new concepts that students may not learn on their own (Gall & Gall, 1976; Myers & Lamm, 1976; Slavin, 1977).

The Cognitive Perspective of Collaborative Learning

The following describes cognitive elaboration and development from the cognitive perspective of collaborative learning theory. It discusses the challenges associated with implementing cognitive elaboration and development. Then, it proposes online facilitation as a solution to overcome these challenges

Cognitive Elaboration and Development. Collaborative learning refers that group members develop and share meaning about a group work (Webb & Palincsar, 1996). The cognitive perspective of collaborative learning theories focuses on knowledge restructuring by group members through cognitive elaboration and development processes. Cognitive elaboration emphasizes on group activities that promote cognitive information processing (CIP) (Dansereau, 1988; O'Donnell & Dansereau, 1992). CIP activities include assimilation and accommodation that connect newly learned materials to prior knowledge, restructure existing knowledge structures, and verbalize learned knowledge with group members (Driscoll, 2000; Piaget, 1980). These CIP activities facilitate learners to establish meaningful learning and enhance learning

achievement (Ausubel, 1963a; Wittrock, 1986). Cognitive development focuses on learners' development of new cognitive structures within groups. Vygotskians' view of cognitive development is that cognitive structure is developed in the process of interaction through a combination of mediation and modeling from group members (Brown & Ferrara, 1985; Tudge, 1990; Wertsch, 1979). For maximizing learning achievement, the task given to a learner should be within the learner's zone of proximal development (Vygotsky, 1978). Scaffolding instruction and reciprocal teaching are pedagogies founded on the Vygotskian cognitive development (Palincsar & Brown, 1984). Piagetians' view of cognitive development is that conceptual growth occurs through the processes of disequilibration and re-equilibration within group interaction (Driscoll, 2000; Piaget, 1969). The cognitive development process starts from social interaction, to cognitive conflicts, to resolving conflicts, and ends at cognitive restructuring (Piaget, 1969).

Challenges in Implementing Cognitive Elaboration and Development. When implementing cognitive elaboration and development for cognitive restructuring, two major challenges emerge that affect learning achievement. One challenge is participation in activities, which is influenced by various factors, such as group size, group composition, status, gender, and member ability (Berger, Rosenholz, & Zelditch, 1980; O'Donnell & O'Kelly, 1994; Webb, 1989; Webb & Palincsar, 1996). Without active involvement, learners will not constantly test their perceptions of concepts and may benefit less from collaborative learning experience for knowledge growth. The other challenge is learners' ability to facilitate group members. Group members may not have advanced knowledge and scaffolding, social, and metacognitive skills to provide effective help to each other (Ellis & Rogoff, 1982; Radziszewska & Rogoff, 1988; Webb, 1989).

Facilitation as A Solution. To overcome these challenges, increasing and facilitating interaction for cognitive restructuring is suggested. Facilitation, such as providing prompts, suggesting alternatives, requesting explanations from students, selecting tasks, organizing learning environments, creates opportunities for cognitive elaboration and development toward cognitive restructuring (O'Donnell & O'Kelly, 1994). Exemplar pedagogies for facilitation cognitive restructuring in face-to-face instruction are Scripted Cooperation (Dansereau, 1988), Jigsaw (Aronson, Stephan, Sikes, Blaney, & Snapp, 1978), Structured Controversy (Johnson & Johnson, 1987), and Student Team Achievement Divisions (Slavin, 1978, 1987). Apparently, these pedagogies in face-to-face learning can be and have been applied to online learning through various types of online facilitation.

Online Facilitation

The following describes three types of online facilitation by its initiation. They are student-, system-, and facilitator-initiated facilitations. Then, it discusses the advantages and disadvantages of each type of online facilitation.

Student-initiated Facilitation. Online facilitation is widely implemented in most online learning systems (Aleven et al., 2003; Grasel et al., 2001; Slotta & Linn, 2000). The most common type of online facilitation is on-demand help that responds to student's requests for help (Aleven & Koedinger, 2000; Grasel et al., 2001; Shute & Gluck, 1996; Slotta & Linn, 2000). While having students initiate help requests is likely to provide just-in-time explanation for constructing new knowledge (Renkl, 2002), it requires students' ability to seek help in an appropriate manner (Aleven et al., 2003). This requirement may impede effective learning for less able students who mostly need help but are not good at seeking help (Aleven et al., 2003; Renkl, 2002; Wood & Wood, 1999).

System-Initiated Facilitation. Alternatively, placing help initiation under the online learning system is to implement a computer tutor whose job is to provide contingent help according to the learner's needs, like human tutors do (Wood & Wood, 1999). But, it is difficult for a computer tutor to judge when the learner is indeed in need of help, since a computer tutor has no judgment and is unlike human tutors who can pick up verbal and nonverbal cues. As a result, students did not use on-demand facilitation effectively or even ignore it, although it is believed that on-demand help is useful when used appropriately (Aleven et al., 2003; Renkl, 2002; Wood & Wood, 1999). While both student-requested help and system-initiated help reveal inherent weaknesses, further research to uncover a better balance between these two approaches is recommended (Luckin & du Bailay, 1999).

Facilitator-Initiated Facilitation. Online facilitation can be implemented through not only system-initiated on-demand help, but also facilitator-initiated online help (Chang, 2004a, 2004b). Online facilitators, or online mentors, were trained to offer extra assistance for students in comprehending course contents in addition to instructors' instruction, to initiate online

learning communities, and to support technical problem-solving. Online facilitators could make judgment to offer additional help to needed students, compared to computer systems which has no judgment. Online facilitators could also provide more effective help, compared to student group members who might not have sufficient scaffolding, social, and metacognitive skills to provide useful help to each other (Ellis & Rogoff, 1982; Radziszewska & Rogoff, 1988; Webb, 1989). The contribution of online facilitators in assisting online learning and teaching was recognized greatly by both students and faculty. Also, students received assistance from online facilitators achieved higher course completion rates and learning achievement then students who did not (Chang, 2004a, 2004b).

Purpose and Significance of the Study

Purpose of the Study. This study examines the effects of online facilitation (low-level or high-level) on cognitive restructuring and learning achievement. Low-level facilitation provides system-initiated facilitation. High-level facilitation employs the course facilitator, an online facilitator, to provide extra help based on the facilitator's judgment on students needs for help and to respond to student-requested help, in addition to the low-level facilitation provided by the system. It is expected that students with the course facilitator's assistance, in addition to the system-initiated facilitation, may perform better in cognitive restructuring and learning achievement.

Significance of the Study. This study departs from existing studies in several important aspects of the research design. First, this study examines the impact of facilitation on cognitive restructuring during online discussion, which serves as the intermediate factor to explain online learning achievement. Second, this study employs a course facilitator who can increase interaction by providing extra facilitation based on his/her judgment on students needs for help

with or without students' requests, in addition to the low-level, system-initiated, facilitation. Third, this study compares effects of two levels of facilitation. Low-level facilitation provides system-initiated facilitation and high-level facilitation provides facilitator-initiated plus system-initiated facilitation for cognitive restructuring during online discussion.

Method

Research participants were 29, 21 female and 8 male, graduate students enrolled in a graduate course in the College of Education at a large southeastern state university in the Spring 2001 semester. Participation in this study was voluntary.

This study was conducted in a single graduate online course taught by an instructor and assisted by a course facilitator, who has advanced knowledge of the course content and facilitation skills to assist online learning. This course consists of two separate course sections, and each section is contained within its own course website. The two course websites were identical and had exactly the same instruction, activities, assignments, and online discussion questions. However, online discussion of each section was held within its own course website without cross-section online discussion. Online facilitation for one section was constrained within that section in a particular stage of this research study.

The Research Design

Intact classes were used for treatment groups in this study. Students in the two sections of this course formed the two research groups. Random group assignment was not applicable in this study because that the enrollment office at the university, rather than the researcher, assigned students to these two sections according to the university enrollment policy.

Repeated measures design, which all participants received both levels of treatments (Myers, 1972), was employed in this study. Due to the limited number of participants (29 in

total) and using intact classes for treatment groups, a repeated measures design was chosen so that the observations were doubled and the potential impacts of individual differences might be alleviated.

Procedure

A survey was administered at the beginning of the semester to collect demographic data. The repeated treatments, low-level and high-level facilitations, were given to students during stages 1 and 2, or weeks 2-7 and 8-14 (Table 1). In stage 1, section 1 received high-level facilitation while section 2 received low-level facilitation. In stage 2, section 1 received low-level facilitation while section 2 received high-level facilitation.

Table 1

Repeated measures design: Treatments and Measurements

Stage	Treatment & Measurement	Week	Section 1	Section 2
			High-to-low facilitation sequence	Low-to-high facilitation sequence
	Pretest	1	Pretest and Survey	Pretest and Survey
Stage 1	Treatment	2-7	High-level facilitation	Low -level facilitation
	Measurement	7	Cognitive restructuring in discussion messages and learning achievement	Cognitive restructuring in discussion messages and learning achievement
Stage 2	Treatment	8-14	Low-level facilitation	High-level facilitation
	Measurement	14	Cognitive restructuring in discussion messages and learning achievement	Cognitive restructuring in discussion messages and learning achievement
	Posttest	15	Posttest	Posttest

Treatments and Measurements

The following describes two treatments and two measurements used in this study. Facilitation and facilitation sequence are the two treatments. Cognitive restructuring and learning achievement are the two measurements.

Facilitation. The facilitation (low or high level) was a treatment that students received during online discussion. At the low-level facilitation, the learning system presented instruction and pre-designed questions to guide each online discussion activity. Students discussed the assigned topics with peers without assistance from or interaction with the course facilitator. At the high-level facilitation, the course facilitator provided extra assistance for cognitive restructuring in addition to the low-level facilitation. The course facilitator encouraged and monitored students' discussion, provided cues to prompt students' self-questioning, directed attention to the key concepts, made suggestions, and responded to student-requested help during online discussion. Discussion activities with examples in low-level and high-level facilitation are presented in Appendices A and B.

Facilitation Sequence. The facilitation sequence (low-to-high or high-to-low) was the order of facilitation levels that was administered. Students in the low-to-high facilitation sequence section received low-level facilitation at the 1st stage and high-level facilitation at the 2nd stage. Oppositely, students in the high-to-low facilitation sequence section received high-level facilitation at the 1st stage and low-level facilitation at the 2nd stage.

Cognitive Restructuring. Cognitive restructuring was the changes of cognitive structure from low-level to high-level facilitation concerning learned concepts presented in online discussion messages and was measured by the instrument: Scoring rubric for cognitive structure,

with a 4-point scale. Gained, or changed, scores were used in this study due to the repeated measures design (Weinfurt, 2000).

Learning Achievement. Learning achievement was observed via two learning gains, one from facilitation level and the other from facilitation sequence. Learning gain from facilitation level was defined as the additional points a student earned from the assignment in low-level to the assignment in high-level facilitation. Learning gain from facilitation sequence was defined as the additional points a student earned from pretest to posttest. The assignments, pretest, and posttest were graded on a 4-point scale, from 4-1 points, converted from letter grades (A-D), correspondingly.

The Instrument

The following describes the instrument, Scoring rubric for cognitive structure, used in this study. It presents the rationales for a new instrument and constructs used to develop this instrument. Then, it discusses the validity and reliability of this instrument.

Scoring Rubric for Cognitive Structure. The instrument, the Scoring rubric for cognitive structure (Appendix C), was developed by the researcher to measure cognitive restructuring on a 4-point scale for each message posted by students in online discussion activities. The Scoring Rubric Assessment Technique was used because the performance of cognitive restructuring was complex and holistic in nature, which would be best scored holistically (Oosterhof, 2001).

Rationales for A New Instrument. Many instruments have been developed for measuring cognitive structure, such as: multidimensional scaling (MS) (Shepard, 1980), sentence verification technique (SVT) (Royer, Marchant, Sinatra, & Lovejoy, 1990), and conceptual relationship rating (CRR) (Konold & Bates, 1982). However, these instruments are not suitable for this study because MS and SVT are extremely tedious and time consuming to score and not

feasible for measuring large amount of concepts in this study. CRR is content dependent and impossible to measure concepts other than the original concepts (Royer, Cisero, & Carlo, 1993). Thus, a new instrument, the Scoring rubric for cognitive structure, was developed for this study.

Constructs of the Instrument. The constructs of this instrument were founded on theories and studies of meaningful learning (Ausubel, 1963a), reflective processes (Scardamalia, Bereiter, & Steinbach, 1984), critical thinking assessment (Ennis, 1993), and universal intellectual standards for critical thinking (Elder & Paul, 2000). Ideas of these theories and studies were incorporated into the development of the constructs for cognitive restructuring by the researcher. These constructs were: 1) focus on the topic, 2) usage of supporting ideas or examples, 3) establishment of relevance among concepts or theories, 4) application of a concept or theory in a new situation, 5) logical analysis of a concept or a theory, 6) expression of an alternative view, and 7) the identification of conclusions, reasons, patterns, or assumptions.

Validity and Reliability. The validity of this instrument was reviewed by three subject matter experts for content validity and suitability of the scaling, in addition to the theoretical grounded constructs. The reliability of this instrument was assured with two formative evaluations implemented on the discussion messages from the same course in the previous semester. Modifications of the instrument were made according to the recommendations from subject matter experts and evaluators. Among several modifications, the major modification was to change the 5-point to 4-point scale by combining two largely overlapped levels that potentially imposed difficulty in using the instrument.

Data Analysis

Nonparametric data analyses were employed in this study due to intact classes for treatment groups, small sample size, and normality violations. As mentioned previously, intact

classes were used in this study due to the course enrolment policy at the university, which made the random grouping method inapplicable. The number of total participants in this study (29) was small, which was not considered as appropriate for applying parametric data analyses (Hair, Anderson, Tatham, & Black, 1998). The inter-rater reliability of cognitive restructuring was significant among three raters (Pearson correlations $r_{ratersA,B}$= .73, $r_{ratersB,C}$= .76, $r_{ratersA,C}$= .89). A significance level of .05 was used for statistical tests in this study. Initial analysis also found that students' age and gender were not significantly correlated with any measurement. Thus, these two variables were dropped in subsequent analyses.

Results

Overall, 29 (21 female and 8 male) graduate students participated in this study. There were 5 non-experienced students who had no previous experience in taking online courses and 24 experienced students who had taken at least one online course prior to this course.

The cognitive restructuring (mean rank=-5.38) was negative, which revealed that students performed less cognitive restructuring in high-level facilitation, compared to low-level facilitation. The learning gain from facilitation level (mean rank=6.81) was positive, which indicated that students achieved higher learning outcomes in high-level facilitation, in contrast to low-level facilitation. Both cognitive restructuring and learning achievement were not statistically significant. However, the correlation between cognitive restructuring and learning gain from facilitation level was significant (Wilcoxon Signed Ranks for interval-ratio data Z=-3.77; p <.00).

For experienced students, both mean ranks of cognitive restructuring and learning gain from facilitation level were higher than those of non-experienced students (Table 2). The experienced students significantly outperformed the non-experienced students in cognitive

restructuring (Mann-Whitney test U=25; p=.04) and learning gain from facilitation level (Mann-Whitney U=18; p=.01) (Table 3).

Table 2

Mean Ranks of Cognitive Restructuring and Learning Achievement by Experience

	Cognitive restructuring		Learning achievement	
	Non-experienced	Experienced	Non-experienced	Experienced
N	5	24	5	24
Mean Rank	8.00	16.46	6.60	16.75
Sum of Ranks	40.00	395.00	33.00	402.00

Note. Cognitive restructuring and learning achievement were on a 4-point scale.

Table 3

Cognitive Restructuring and Learning Achievement by Experience

Test Statistic	Cognitive restructuring	Learning achievement
Mann-Whitney U (for nominal independent variables)	25.00	18.00
Z	-2.02	-2.48
Asymp. Sig. (2-tailed)	.04*	.01*

*Significant at .05 level (2-tailed)

The mean rank of learning gain from facilitation sequence in low-to-high facilitation sequence section (mean rank=14.94, sum of ranks=239.00) was lower than that in high-to-low facilitation sequence section (mean rank=15.08, sum of ranks=196.00) (Table 4). However, no significant difference between sections was found for learning gain from facilitation sequence.

Table 4

Mean Ranks Learning Gain from Facilitation Sequence

	Learning gain	
	Facilitation sequence	
	Low-to-high	High-to-low
N	16	13
Mean Rank	14.94	15.08
Sum of Ranks	239.00	196.00

Note. Unit of learning gain from facilitation sequence was on a 4-point scale.

Discussion

This section discusses the results of cognitive restructuring, online facilitation, and learners' prior experience in online learning concerning learning achievement. Finally, it describes the limitations of this study followed by a summary of the findings of this study.

Cognitive Restructuring and Learning Achievement

Significant correlation between cognitive restructuring and learning achievement indicates that more cognitive restructuring leads to higher learning achievement. This finding confirms the imperative influence of cognitive restructuring on online learning effectiveness (Ausubel, 1963a) and is consistent with the findings in previous studies (Bargh & Schul, 1980; Gall & Gall, 1976; Myers & Lamm, 1976; Slavin, 1977). This finding also suggests that online pedagogies should emphasize more on creating online interaction that stimulates and facilitates cognitive restructuring for optimizing online learning effectiveness.

Online Facilitation

Online facilitation had no significant impact on cognitive restructuring and learning achievement. As a result, no significant difference between sections was found for learning achievement concerning facilitation sequence. These findings do not support the hypothesis in this study. The reason why high-level facilitation did not significantly stimulate more cognitive restructuring nor assist higher learning achievement may be because that the pre-designed questions provided by the learning system to guide online discussion activities in the low-level facilitation may have been sufficient for cognitive restructuring and comprehending the learning content. That makes the extra help provided by the online facilitator for cognitive restructuring in high-level facilitation less essential. This finding suggests that well-designed guidelines for facilitating online discussion provided by the learning system can offer sufficient facilitation for cognitive restructuring to achieve learning effectiveness, although the learning system has no humanlike judgment to pick up verbal and nonverbal cues (Wood & Wood, 1999). The finding also suggests that system-initiated facilitation may substitute, to some extent, student-requested facilitation for cognitive restructuring. Students who are not aware of the need of help or do not know how to request help can also benefit from system-initiated facilitation. In regular classroom learning, system-initiated facilitation for cognitive restructuring is negligible and learning effectiveness depends predominantly on student-requested, or on-demand, facilitation. In online learning, system-initiated facilitation for cognitive restructuring may well be a basic component of instructional design. The importance and the role of system-initiated facilitation for cognitive restructuring may have long been downplayed. Thus, this finding concerning the effectiveness of online facilitation for cognitive restructuring calls for further research on: What are the crucial factors for facilitating cognitive restructuring in online discussion? What are the design principles for online facilitation toward optimizing cognitive restructuring in online discussion?

Experience in Online Learning

The experienced students significantly outperformed the non-experienced students concerning both cognitive restructuring and learning achievement. This finding should be considered as an expansion of the conclusion in Althaus' (1997) study that proposes prior experience in online learning is positively related to cognitive restructuring. Experienced students are familiar with online learning systems and possess the necessary cognitive skills to find their focus on key elements, to make connections to prior knowledge, and to make cognitive changes (Althaus, 1997; Guzdial, Kehoe, & Turns, 1997; Hiltz, 1994; Hmelo et al., 1998). Thus, experienced students tend to respond favorably to facilitation while constructing new knowledge. This finding suggests that facilitation is particularly effective for experienced students towards enhancing their learning achievement.

Limitations

The two major limitations of this study are small sample size (29 participants) and using intact classes for treatment groups. The small sample size limits the ways to categorize the variables into sufficient number of observations for data analysis. Using intact classes, instead of random group assignment, may present biased equating of treatment groups and lead to potential rival explanations of results (Krathwohl, 1997). Although a repeated measures design and non-parametric data analysis methods were used to overcome these limitations, potential bias of findings may still exist. Accordingly, generalizations of the findings from this study should be applied with due caution.

Summary

This study found no significant effects of employing an online facilitator to provide extra facilitation in addition to the system-initiated facilitation. This finding suggests that well-

designed system-initiated facilitation on cognitive restructuring may be sufficient for effective online learning and can compensate student-requested facilitation. This study also found a significant correlation between cognitive restructuring and learning achievement, which confirms the importance of facilitating cognitive restructuring for effective online learning (Ausubel, 1963a, 1963b; Piaget, 1980; Vygotsky, 1978). This finding suggests that creating online interaction for facilitating cognitive restructuring should be incorporated into online pedagogy for optimizing online learning effectiveness.

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Appendix A

Low-level Facilitation Activities

Activity Number	Week Number	Activity Type	Description
1.2	1	Small group discussion	Post your group's completed answers to the metaphor questions as part of this forum
1.7	3	Class discussion	Discuss the questions posted by the instructor
2.10	6	Class Discussion	Class Discussion - Your Perspective
3.3	8	Class discussion	This forum is a group-led conference on Meaningful learning and Schema theory.
3.6	9	Class discussion	In this forum, you will discussion distance learning.
	13	Ask the expert	"Ask the Expert" session with Dr. Cunningham.
3.9	10	Class discussion	This forum is group-led conference on Cognitive and Knowledge Development.
3.12	11	Class discussion	This forum is group-led conference on Interactive Theories of Cognitive Development.
3.19	15	Class discussion	In this forum, you will argue for strengths and weaknesses of this course, from three different theoretical perspectives.

An Example of Low-level Facilitation

Activity 2.3: Individual Exercise on Discussion Board

In this forum, you will post your specific example of behaviorism in action. You will reply to the thread "Directions."

Low-level Facilitation

(Total number of messages posted by the facilitator in this activity: 1)

Message #	Message Topic, Author, & Date
1	Directions, COURSE FACILITATOR, 16-Jan-2001
	Give one specific example of behaviorism in action. The example should reflect one or more of the key concepts found in Chapter 2 of the Driscoll text (see Activity 2.1 for a complete list of concepts). For example, a scenario in which the behaviorist orientation is presented might include a description of positive reinforcement and shaping. The xample can be based on your own personal experience as a learner, teacher, and/or observer. If you cannot think of a real life example, make up an example. The context for your example can be based on an audience and media delivery system of your choosing. Be sure to include a rich description of the scenario. Ask yourself the following questions: Who is learning what and why? In what context or setting is the example based (home, work classroom)? What characteristics of the learner and the learning environment are of importance to the theoretical perspective being exemplified?
	Re: Behaviorism in Action, CHUCK D., 31-Jan-2001
	Fading and reinforcers, behaviorism..., JOHN A., 01-Feb-2001
	Re: Directions, SHANON D., 01-Feb-2001
	Mutt the circus dog, ROBERTO A., 01-Feb-2001
	Re: Mutt the circus dog, ANDY, 02-Feb-2001

------ Online discussion continued ------

Appendix B
High-Level Facilitation Activities

The following lists the conditions and actions for high-level facilitation activities provided by the course facilitator, in addition to the low-level facilitation. The high-level facilitation emphasizes on assisting cognitive restructuring.

Conditions and Actions

As low-level facilitation initiates online discussion by providing the basic theme of each discussion activity, the high-level facilitation is to provide extra assistance in addition to the initiation of a discussion with a focus on cognitive restructuring. The following table lists the tasks, which include conditions of online discussions and corresponding actions. Conditions are the indicators that may show the discussion is off-task or express the needs of extra facilitation. Actions are potential solutions that the facilitator may take to encourage cognitive restructuring processes.

Condition	Action
1. The content of a message of on-line discussion is off-task.	- Send an email message to the group to remind them to remain relevant to the main point
2. Clarifying a specific concept or theory and none of the group members tries to help him/her	- Point to a reference which contains the needed information - Provide the information which is asked - Explain the key points of a concept or theory - Elaborate a view point - Provide examples - Provide an alternative view of a concept - Remind prior knowledge - Reword statements - Confirm a view point or a concept
3. Expressing confusion of a concept or learning theory and none of the group members tries to help him/her	- Provide definition - Clarify the concept by providing similarity and difference - Explain the key points of a concept or theory - Elaborate a view point - Provide examples - Establish relevance between this concept and prior knowledge - Reword statements - Breaking one concept into two or more components - Point out logic relationships or causal effects
4. Expressing a wrong interpretation concept or theory and none of the group members tries to correct it	- Providing definition and clarifying his/her thoughts - Explain the key points of a concept or theory - Elaborate a view point - Provide examples
5. Having difficulty in establishing relevance among concepts and none of the group members tries to help him/her	- Remind prior knowledge - Show and explain the relationships among concepts
6. Having difficulty in interpreting a concept or theory and none of the group members tries to help him/her	- Provide example and metaphor of the concept or theory - Elaborate the concept or theory - Made references to other concepts or theories
7. Having difficulty in synthesizing multiple concepts or theories and	- Explain how to combine those concepts or theories - Addressing the complexities and relevance among those

none of the group members tries to help him/her	concepts or theories - Suggesting considering an alternative view of those concepts or theories - Presenting situations for using those concepts or theories - Identifying conclusions, reasons, patterns, and assumptions among those concepts or theories - Integrating multiple concepts or theories

An Example of High-Level Facilitation

Activity 2.3: Individual Exercise on Discussion Board

In this forum, you will post your specific example of behaviorism in action. You will reply to the thread "Directions."

High Level Facilitation

(Total number of messages posted by the facilitator in this activity: 4)

Message #	Message Topic, Author, & Date
1	Directions, COURSE FACILITATOR, 16-Jan-2001
	Give one specific example of behaviorism in action. The example should reflect one or more of the key concepts found in Chapter 2 of the Driscoll text (see Activity 2.1 for a complete list of concepts). For example, a scenario in which the behaviorist orientation is presented might include a description of positive reinforcement and shaping. The example can be based on your own personal experience as a learner, teacher, and/or observer. If you cannot think of a real life example, make up an example. The context for your example can be based on an audience and media delivery system of your choosing. Be sure to include a rich description of the scenario. Ask yourself the following questions: Who is learning what and why? In what context or setting is the example based (home, work classroom)? What characteristics of the learner and the learning environment are of importance to the theoretical perspective being exemplified?
2	Behaviorism in the Computer Lab, DEBBIE E., 28-Jan-2001
3	Behaviorism in serving, KATHY M., 30-Jan-2001
4	Re: Behaviorism in serving, ALEX Y., 03-Feb-2001
5	Behaviorism in Counseling, SHESHA., 30-Jan-2001
6	Limitations of Behaviorial Appro..., COURSE FACILITATOR., 01-Feb-2001
7	Re: Limitations of Behavioris..., DON M., 01-Feb-2001
8	Re: Limitations of Behavio..., COURSE FACILITATOR., 02-Feb-2001
9	Re: Limitations of Behavioria..., ERIANA K., 02-Feb-2001
10	Re: Limitations of Behavioria..., LUCY A., 12-Feb-2001
11	Behaviorism in K4, STEVE, 01-Feb-2001
12	Re: Behaviorism in K4, LUCY A., 12-Feb-2001
13	Behaviorism in action - Discriminat..., VICTOR M., 03-Feb-2001
14	Re: Behaviorism in action - Disc..., COURSE FACILITATOR., 03-Feb-2001
15	Behavioral Example, JONASSON O., 03-Feb-2001
16	Re: Behavioral Example, ALEX Y., 03-Feb-2001

------ Online discussion continued ------

Appendix C
Scoring Rubric for Cognitive Structure

Score	***Description of Performance***
4	- Discussion is focused on the topic of this activity. - Ample supporting ideas or examples are used. - Relevance among concepts or theories is established with strong evidence. - A concept or a theory is properly applied in a new situation. - Logical analysis on a concept or theory is demonstrated. - Clear expression of an alternative view about a concept or theory is presented. - Rational conclusions, reasons, patterns, or assumptions are identified.
3	- Discussion is focused on the topic of this activity. - Supporting ideas or examples are used. - Relevance among concepts or theories is established with evidence. - A concept or a theory is applied in a new situation with a few minor flaws. - Logical analysis on a concept or theory is demonstrated with few lapses. - Expression of an alternative view about a concept or theory is presented with some ambiguity. - Conclusions, reasons, patterns, or assumptions are identified.
2	- Discussion contains ideas extraneous to the topic of this activity. - Supporting ideas or examples are occasionally used. - Relevance among concepts or theories is established with weak evidence. - A concept or a theory is applied in a new situation with a few major flaws. - Logical analysis on a concept or theory is demonstrated with some lapses. - Expression of an alternative view about a concept or theory is presented with some confusion. - Conclusions, reasons, patterns, or assumptions are identified with little rationality.
1	- Discussion is slightly related to the topic of this activity - Supporting ideas or examples are rarely used. - Relevance among concepts or theories is established with very weak evidence. - A concept or a theory is applied in a new situation with many major flaws. - Logical analysis on a concept or theory is demonstrated with many lapses. - Expression of an alternative view about a concept or theory is presented with confusion. - Conclusions, reasons, patterns, or assumptions are identified with little rationality.
0	- Discussion is not related to the topic of this activity. - No supporting ideas or examples are used. - No relevance among concepts or theories is established. - No concept or theory is applied in a new situation. - No logical analysis on a concept or theory is demonstrated. - No expression of an alternative view about a concept or theory is presented. - No conclusions, reasons, patterns, nor assumptions are identified.