A QUALITATIVE STUDY OF PARTICIPATION OF STUDENTS IN ONLINE

DISCUSSION IN MATHEMATICS

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Seo, Daeryong

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COMMITTEE MEMBERS

Committee Chair: Susan Powers, Ed.D.

    Professor in Curriculum, Instruction, and Media Technology

    Indiana State University

Committee Member: Susan Kiger, Ph.D.

    Professor in Curriculum, Instruction, and Media Technology

    Indiana State University

Committee Member: Marylin Leinenbach, Ph.D.

    Associate Professor in Elementary, Early, and Special Education

    Indiana State University

ABSTRACT

Despite many recent developments in technology, there are still many people who are not fully utilizing advanced technologies to enhance learning. This issue has an impact on K-12 schools as well as higher education and makes a case for the development of better distance education programs, which can assist students in studying more effectively both in and out of the classroom. In particular, online discussion in distance education can encourage students who are having difficulty in solving mathematical word problems on tests. The purpose of this study was to understand the behavior, motivation, and interests of teacher education students who need remediation by means of online discussion in mathematics. In addition, this study aimed at investigating the benefits and drawbacks of online discussion boards when teacher education students participate in online discussions for math remediation as well as the degree to which an expert facilitator impacted the online remediation. For this study, 12 students participated in an online discussion forum related to mathematics word problems, and six students participated in virtual focus group interviews. The participants were divided into two groups: one with an online expert facilitator and one without.

The results showed the importance of an online facilitator and social interaction in the online discussion board. Students posted and shared new ideas and opinions and enjoyed their online discussion activities. The reported advantages of the online discussion were no-time and space limitations and the improvement of critical thinking ability, and the reported disadvantages

of the online discussion were time lag, only text-based settings, and unfamiliar interface as well as the possibility of plagiarism of others' ideas and opinions. This study took place over a period of one week for online discussion in mathematics word problems. It is hoped that the results of this study will have implications for educators working with distance education settings.

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INTRODUCTION

Statement of the Problem

Despite the fact that there are various opportunities for learning on and practical uses of the computer and the Internet, many Americans are unable to take advantage of these (Bobak, Cassarino, & Finley, 2004). In general, people cannot be expected to be familiar with technology if they do not learn how to use technology appropriately or have few opportunities to do so. This issue is especially relevant to K-12 and higher education, both of which are currently converting to wireless or other technology and requiring that students use laptop computers (Bobak et al.. 2004). In particular, students with a low socioeconomic status might not have access to computers at home even if they can use computers at school. Due to this fact, it is very important for schools to help students who cannot access computers at home to be able to use computers without time or space restrictions. This support can provide opportunities to students so that they can become familiar with technology and take advantage of all that it has to offer.

In addition to ensuring that all students have access to technology, there are several methods by which learning can be promoted by the use of computers. Distance education, for example, is one way that can help students to study effectively out of as well as in class. Distance

education settings offer flexible and interactive functions and can lead to access of various resources that facilitate the process of teaching and learning. The technology used in distance learning settings encourages students to study together and develop their thinking more effectively than through interaction they might have during teacher-centered lectures (Herring, 2004). Software packages like Blackboard or Moodle can enable students to study effectively through distance learning. According to Beatty and Ulasewicz (2006), "Blackboard is one of the leading commercial LMS (or CMS) software packages used by North American and European universities" (p. 37). In the opinion of some, Moodle is particularly flexible, even more than with Blackboard. "Moodle is a course management system (CMS)–a free, Open Source software package designed using sound pedagogical principles, to help educators create effective online learning communities" (Beatty & Ulasewicz, 2006, p. 36). Moodle also has a free format that enables its users to organize distance learning settings more effectively.

One important function of a CMS is the online discussion board. Discussion in-class can be extended if students use these online discussion boards (Johnson & Green, 2007). Learners can also create and cultivate their social relationships with others by accessing this discussion board (Palloff & Pratt, 2007, p. 14). They can also build connections as they share their ideas and thoughts. In this way, distance learning with online discussion is related to social learning.

One of the most prominent educators to speak about social learning was Lev Vygotsky, who defined and discussed "private speech," "zone of proximal development," and "scaffolding" as important aspects and benefits of this type of learning (Grabe & Grabe, 2007, p. 69). In terms of private speech, Vygotsky wrote that adults as well as children tend to talk to themselves when they encounter difficult tasks. They use externalized speech in order to solve their problems and

convert externalized speech to inner speech. It is very significant for learners to talk to themselves and think about their external mechanisms when they solve problems. They also write what they think using external mechanisms such as discussion boards, where others can observe them. The zone of proximal development is a concept that assumes if learners perform with the appropriate support of instructors or peers, they can complete even difficult tasks which "are far beyond the capability of the learner" (Grabe & Grabe, 2007, p. 69). Related to this, learners who use online discussion boards can learn through others' comments and ideas. Vygotsky's notion of scaffolding stresses the importance of work that is given by a guide or facilitator to learners in order for them to develop their capability to complete tasks. When these tasks are given to learners in an online setting, it is my opinion that learners can accomplish them through online discussion. In other words, many of the functions of Vygotsky's social learning can be accomplished in an online setting.

Furthermore, distance learning by means of online discussion is needed for the remedial learning of college students. At most colleges, many students have a lack of basic academic skills in mathematics, reading, and writing, so they are not able to do college level work (Zeidenberg, 2008). In order to solve this problem, 91% of public colleges offer remedial courses in mathematics and English (Hagedorn, Siadat, Fogel, Nora, & Pascarella, 1999). Parmer and Cutler (2007) also argued that remedial programs should be provided for academically deficient students. Colleges need to offer various remedial programs for students who need developmental education for college-level study. Moreover, Kulik, Kulik and Schwab (1983) stated that remedial learning results in academic success. "Remediation provides many mathematically underprepared students with the skills they need to succeed in higher level courses and to

advance in the broader socioeconomic context" (George, 2010, p. 83). On the other hand, Bahr's (2008) study reported that three out of four remedial math students did not succeed even with remediation and that remediation only worked well for some students. These data indicate that successful remediation programs depend on good content, structure, interaction, and balance. Online remedial programs for college students can provide this structure and enable students to study freely without time or space restrictions. In addition, active students' participation in online discussion boards through sharing ideas and information with their peers and the instructor in a social learning format encourages students to develop problem-solving skills and higher order thinking as well as become familiar with the basic skills of mathematics and other subjects. Active interaction with well-organized content in distance learning enables college students to achieve their goals successfully.

Online discussion also enables teacher education college students to improve their academic achievement and obtain their goals. In the United States, these students are required to take a Praxis I test in order to measure their fundamental skills in reading, writing, and mathematics in preparation for a career in education. However, according to Xin and Jitendra (1999), some of these students have had difficulty solving mathematical word problems on the Praxis I test. In this test, students are faced with mixed problems such as mathematical language and natural language when they solve mathematical word problems. Mathematical language is expressed by concepts, symbols, axioms, patterns, and theorems, and natural language is expressed by a diversity of words such as nouns, verbs, and adjectives in a semantic and syntactic context. Concepts can be interpreted differently in natural language and mathematical language. "The structure of mathematical language is more precise and less flexible than the

structure of natural language, thus great tension is created in the use of natural language in

mathematical problems," write Ilany and Margolin, (2010, p. 139). Online discussion may assist

teacher education college students in solving mathematical word problems as well as building a

bridge between mathematical language and natural language for remediation through the sharing

of ideas and information from their peers and the facilitator in a manner that supports social

learning.

Purpose of Study

The goal of this study was to understand the behavior, motivation, and interests of teacher

education students who need remediation by means of online discussion in mathematics. In

addition, the study aimed to investigate the benefits and drawbacks of online discussion boards

when teacher education students participate in online discussions for math remediation as well as

how much an expert facilitator impacted the online remediation. The research objectives were

1. To understand teacher education students' behavior about participation in online

   discussions. The participants were 12 teacher education students preparing for the Praxis

   I math exam at Indiana State University, Terre Haute, Indiana. I observed the

   participation of students in online discussion and transcribed students' behavior on online

   discussion rubrics.

2. To investigate teacher education students' motivation and interest in participation in

   online discussions and the advantages and disadvantages of participation in the online

   discussion for remediation. Asynchronous virtual focus group interviews were performed.

   The subjects of the interviews were the participants who joined the online discussion

   board. In addition, those focus groups were divided into two: a group with an expert

facilitator and a group without an expert facilitator, in order to investigate the effect of an expert facilitator in an online discussion board.

Research Questions

For the study, the following questions were explored:

1. How do teacher education college students who need remediation behave in an online discussion board in mathematics?

2. What are the students' motivation and interest after they participate in the online discussion board in mathematics?

3. What are advantages and disadvantages of participation in the online discussion for remediation from the point of view of the students in mathematics?

4. To what extent does an expert facilitator impact the online remediation?

Methods

To answer the research questions, a qualitative method was used. Two different types of data were collected for this research. First, a transcription of the students' participation records was used, which were saved in the online discussion board and evaluated according to a rubric instrument for assessing the effectiveness of students' participation in online discussion. Second, asynchronous virtual focus group interviews were used to obtain an understanding of participation in online discussion for the population.

Significance of the Study

The results of the study are intended to promote understanding about learning in an online discussion of a CMS for teacher education students who need remedial learning and instructors in mathematics as well as the benefits of online discussion. In addition, the results

reveal how effective learning by means of online discussion on a CMS can enhance teacher education students' learning, motivation, and interests. Moreover, the results show the effect of an expert facilitator in online discussion for remediation. As a result, the study highlights ways in which instructors and curriculum designers can use a CMS to promote meaningful teaching and learning.

Definition of Terms

1. Moodle: a course management system aimed at creating dynamic online learning communities. Moodle has been used in more than 16 languages in over 115 countries. Teachers have used Moodle as a strong tool for homework, quizzes, chatting room, and surveys (Lauer, 2009).

2. Course management system: a tool that enables instructors to create and manage online course content without an understanding of computer language (Meerts, 2003).

Assumptions

For this study, the following assumptions were made:

1. Participants, who are teacher education students preparing for the Praxis I math exam at Indiana State University, participate in an online discussion board in a Moodle setting.

2. Participants devote enough time in only their assigned Moodle setting.

3. Participants honestly share their opinions and ideas in the asynchronous virtual focus group interview.

Limitations of the Study

This research has four limitations. First, the study was limited to and conducted within a one week period of online discussion. If a longer period of time were used, the results of the study related to students' attitudes and motivations might have been different. Second, it was very difficult for me to manage and control students who participated in the online learning tool at their homes or other places. If students learn in a restricted classroom, an instructor can manage and observe them easily. However, it is not possible for the instructor to observe students' behavior and non-verbal responses such as facial expressions because the instructor cannot watch them taking part in online learning directly. Third, students could copy or imitate peers' thinking and ideas without their own thinking when students post their thoughts and ideas on the online discussion board. This may result in violations of rules of the social learning. Fourth, because there were only five mathematical word problems on the online discussion board, it was difficult to generalize students' motivation and interest in relation to an entire word problem. Fifth, the validity and reliability of the instrument that the researcher used for this study had not been previously tested.

Delimitations

The research was delimited to 12 teacher education students at Indiana State University, Terre Haute, Indiana, U.S. The duration of the research for online discussion research was one week, and each asynchronous virtual focus group interview was limited to one to four days period according to the schedule of participants during the focus group interviews.

CHAPTER 2

LITERATURE REVIEW

An investigation of the behavior, motivation, and interest of teacher education college students who need mathematics remediation through online discussion related to social learning on a web-based program is an important point of this research. In order to design an online discussion forum in a Moodle setting and assess the effectiveness of students' participation and an online expert facilitator, the literature related to theories of online learning and the effects of online learning and online discussion was reviewed.

The first section of the literature review presents a brief history of distance education and current distance learning facts. The second section discusses characteristics that are related to multimedia tools on an online discussion board by describing (a) interactivity, (b) the promotion of mathematical communication, (c) the advantages and disadvantages of online discussion, (d) student teachers' perceptions of computer-mediated discussion, (e) the effects of discussion-facilitating strategy on interaction and satisfaction in online discussion, and (f) the role of a facilitator in online discussions. The third section summarizes theories on constructivism by describing both cognitive and social constructivism. The fourth section states the relationship between the use of technology and the educational achievement of students.

Brief History of Distance Education

The earliest education related to distance learning was correspondence education, which began after the development of a postal service. Related to distance learning, the postal service has been used to carry the lessons and responses of learners. Too much time is required for receiving feedback after lessons were submitted without mail service. In the 1800s, Europe in the pre-industrial era mainly emphasized education for only males in higher levels of society, but the first correspondence programs began to open educational doors and increase enrollment in education (Tracey & Richey, 2005). The movement related to correspondence study was delivered across the ocean to the United States. later. In the United States, the first correspondence school was established in Boston, Massachusetts by Anna Eliot Ticknor in order to give learning opportunities to a larger segment of the population. Young women who had to stay at home were especially able to receive various types of instruction at correspondence schools in the 1800s (Harting & Erthal, 2005). In 1891, Thomas J. Foster started to offer a correspondence course in mining and the safety of mines in eastern Pennsylvania (Tracey & Richey, 2005). In addition, Isaac Pitman in Great Britain offered shorthand courses in accounting by mail in the 1840s. At this time, the development of the postal service allowed schools to offer more degrees in distance learning (Harting & Erthal, 2005).

In 1913, the invention of film by Thomas Edison affected the development of instructional media by the addition of slides and motion pictures. Radio and television also both began to be used for adult education in the 1920s and at the end of the 1930s (Chang, 2006). Instructional television courses were experimented with at the University of Iowa in 1932, and television was used for 17 programs in instructional materials (Harting & Erthal, 2005).

However, college credit courses were not offered on broadcast TV until the 1950s (Tracey &
Richey, 2005). From the 1960s and by 1972, the number of educational TV stations had
increased rapidly and universities had started to build microwave networks that were linked to
on-campus and off-campus sites. Although computers were used in the late 1970s to deliver
education, they had hardware and software limitations as a learning tool. In the 1990s, however,
high-power computers provided education based on telecommunications and many universities
began to offer various online courses for undergraduate and graduate students (Harting & Erthal,
2005).

<div style="text-align:center">Current Distance Learning Status</div>

Rapid changes in technology and market conditions have influenced the delivery format
and facilitated a shift from a face-to-face format to a distance learning format (Chang, 2009).
Today, computer-supported online learning allows institutions of higher education to offer credit
and non-credit courses over computer networks (Tracey & Richey, 2005), and online learning
provides learning opportunities for students who cannot take advantage of traditional face-to-
face programs to obtain a degree due to time and geographical limitations (Chang, 2009). In
addition, laptop computers encourage learners to take advantage of the ability to carry
information and interact with their peers or instructors on the World Wide Web (Tracey &
Richey, 2005).

In 2000 and 2001, "fifty-six percent of two and four-year degree-granting institutions
offered some type of distance learning and 90 percent of those institutions deliver at least some
of their courses via the internet" (D'Orsie & Day, 2006, p. 18). According to the National Center
for Education Statistics (2008), in 2006 and 2007, 66% of Title IV degree-granting

postsecondary institutions in the United States offered distance learning programs. Sixty-five percent of the postsecondary institutions offered credit-granting distance learning courses for the college level and 23% percent of the postsecondary institutions offered noncredit distance learning courses. Moreover, 97% of Title IV degree-granting public two-year institutions in the United States offered distance learning courses. Ninety-seven percent of the institutions offered credit-granting distance learning courses for the college level, and 50% of the institutions offered noncredit distance learning courses in 2000-2001. An example of this was the University of Phoenix, which, according to Kirtman (2009), achieved the fourth highest rank as an online degree provider in the United States.

Characteristics of Interactive Tools With Online Discussion Boards

From a psychological point of view, three dimensions of interactivity with multimedia (the technical dimension, social dimension, and mental dimension) should be considered (Narciss, Proske, & Körndle, 2007a). The technical dimension is associated with location, selection, access, manipulation, and the saving of information. The social dimension is related to contact with online instructors, the exchange of information with other students, and collaborative work. The mental dimension relates to the process of construction of learning materials, engagement in learning activities, and control of the learning process (Narciss et al., 2007a).

Several researchers have studied multimedia interactivity in web-based learning circumstances. According to Chen (1995), interactivity is an important mechanism for effective self-regulated learning in web-based environments. Borsook and Higginbotham-Wheat (1991) stated that web-based learning provides nonlinear access to information and is superior to

conventional instruction. However, Berge (1999) stated that misuse and overuse causes boredom, an overload of information, and superficial information processing. The following functions of interactivity should be considered for effective interactive multimedia tool design (Narciss, Proske, & Körndle, 2007b):

1. Initiating and facilitating access to multiple materials and resources (technical dimension of multimedia interactivity),

2. Initiating and facilitating orientation and navigation (technical dimension of multimedia interactivity),

3. Initiating and facilitating active engagement and constructive processing of the accessible materials and information (mental dimension of multimedia interactivity),

4. Initiating and facilitating elaboration (mental dimension of multimedia interactivity), and

5. Initiating and facilitating monitoring and self-regulation (mental dimension of multimedia interactivity).

Promotion of Mathematical Communication

Tools such as Blackboard or WebCT, which have been used by many schools, enable instructors to post information such as grades and assignments for course management. These tools facilitate learning through online discussion boards. Discussion boards have a function as an area for students to discuss strategies of study, receive some help with content, and promote work. Discussion boards can promote students' communication in a variety of academic subjects, including math (Johnson & Green, 2007).

Recently, the use of communication and writing for mathematics has become an increasingly favorite pedagogical tool (Johnson & Green, 2007). "This momentum is supported by positions taken in national documents such as the National Council for Teachers of Mathematics [NCTM] Principles and Standards for School Mathematics and the Undergraduate Programs and Courses in the Mathematical Sciences: CUPM Curriculum Guide 2004" (Johnson & Green, 2007, p. 326). The NCTM offers school instructional programs that can give students various opportunities for the organization of their mathematical recognition through communication, use of mathematical language, explanation of their mathematical thinking, and assessment of mathematical strategies (Johnson & Green, 2007).

Researchers regard understanding as a potent but not unchangeable process. They state that math understanding is promoted through kinds of metal activities: (a) construction of relations, (b) extension and application of math knowledge, (c) explanation of generalization and procedure, and (d) development of identification, which is associated with having the responsibility to make sense of knowledge in mathematics (Carpenter et al., 2004).

Online discussion boards are used to post math observations from real life that are related to the mathematical content. These observations help students to articulate and identity math content. They also enable learners to see and feel mathematics in real situations and have recognition of the same principles. Moreover, the use of Blackboard facilitates students' learning through math dialogue that is driven by students' interests and contributions. In addition, it can promote a learning community reflecting the different interests, styles, and abilities of the participants involved. Students are able to share their thoughts about real situations that students

have identified and applied the concepts to. The students answer other learners' observations, alter the story in order to express a different point of view, and reorganize the original comment.

Grabe and Grabe (2007) stated four roles of instructors for facilitating students to engage in online discussion boards. The first role is a technical one. An instructor should help students to solve mundane problems that are related to online work and posting. It is very important for the instructor to encourage students to join online discussion boards in a non-threatening way. The second role is social. This role is related to the responsibility of the instructor to help the students meet each other so they can communicate comfortably. The third role is managerial. This role is related to the following tasks: (a) identification of purpose for discussion, (b) definition of roles and students and instructors, (c) maintenance of fresh discussion boards, (d) establishment of primary expectorations for students, and (e) response to productive or inert behavior. The last role is a pedagogical one. This role is related to the evaluation of the performance of students in discussion and the direction for students' "thinking through" strategies.

Advantages and Disadvantages of Online Discussions

Online discussions have several advantages and disadvantages. Pena-Shaff, Altman, and Stephenson (2005) described students' perceived benefits in online discussions. According to these authors, the benefits from online discussion are the following: (a) Since online discussion is asynchronous and prolonged, some students can have much time to prepare and check comments and organize their opinions before posting comments; (b) some students feel that online discussion is better than class discussion for in-depth study, and all students can have same opportunity to communicate their thinking; (c) students can have different perspectives on the same issues and be evaluated with different frameworks,; (d) online discussion can provide

the database for the topics under discussion and help students to integrate class discussion, readings, practices, and lectures; and (e) online discussion can give some students more control over the discussion and help students to feel more comfortable in using the medium than they would in a face-to-face class.

Pena-Shaff et al. (2005) also stated several factors that negatively influence understanding and sharing between students in online discussions. The first is "fear of publicly exposing written comments and sounding ignorant" (Pena-Shaff et al., 2005, p. 420). Some students fear "that their contributions would be attacked or would sound unintelligent when compared to the comments made by more knowledgeable student" (Pena-Shaff et al., 2005, p. 420). In addition, students with inadequate feedback can experience negative feelings. For example, one participant of a research study stated, "I tried to–I think once or twice and when I did, you know, there weren't many follow-ups so that sort of discouraged me not to post anything on my own" (Pena-Shaff et al., 2005, p. 421).

According to Jin's (2005) study, participants listed flexible learning time, the saving of money and time, and the management of learning pace as the main advantages of online interaction. The participants regarded "misinterpretations," "easy to slack if not self-motivated," and "frustrations due to technical problems" as the main disadvantages of online interaction (Jin, 2005, p. 64).

Student Teachers' Perceptions of Computer-Mediated Discussion

Computer-mediated discussion can proliferate interactivity among students because it provides feedback, makes connections, and helps students to share ideas and opinions. Furthermore, written conversations in computer-mediated discussion strongly boosts the

relationships between students and instructors and can lead students to feel connected beyond the in-class setting. However, some students feel unmotivated and uncomfortable with the use of online technology because it is difficult for them to recognize visual and accentual clues in online conversations (Assaf, 2005). According to Ferdig and Roehler (2004), levels of student teachers' interest and the quality of online discussion decrease when student teachers lose the focus of the purpose of the online discussion and cannot boost motivation to interact with students in online discussion.

Related to this study, Assaf (2005) described the implications of the use of online discussion in teacher education programs. Online discussion can promote student teachers to have professional and personal support and facilitate intimate relationships with their peers. In addition, they can use the online discussion forum effectively to construct their content knowledge in teaching and learning. However, a lack of engagement in online discussion can negatively affect learning and students can feel disconnected and estranged from their online community if online discussion is not used in an authentic manner.

Effects of Discussion-Facilitating Strategy on Interaction and Satisfaction in Online Discussion

Discussion-facilitating strategies are divided into two types: motivational strategies and task-oriented strategies. A motivational strategy promotes students' learning by means of praise and encouragement in communication, listening, and opinions so that students can be motivated to actively participate in the online discussion. A task-oriented strategy gives students information requested and feedback about discussion results so that students can focus on their tasks (Han & Park, 2008).

According to Han and Park (2008), the number of participative and interactive postings of motivational strategy groups is statistically significantly greater than that of task-oriented groups. In addition, the levels of satisfaction of motivational strategy groups are statistically significantly higher than those of task-oriented groups. This finding means that students have more interaction and satisfaction when an instructor or facilitator uses motivational strategies in online discussions.

Roles of a Facilitator in Online Discussions

According to the 2010 study by Hew, Cheung, and Ling Ng, 66% of students regard familiarity with the discussion facilitator as an important motivational factor for students to contribute their postings. In addition, 60% of students think that students are motivated to contribute when the facilitator compliments students' contributions. Eighty percent of students agree that the facilitator's responses about their prior contributions motivates students to contribute more, and 86% of students agree that students are motivated to contribute when the facilitator requests elaboration about their thoughts. Moreover, 86% of students think that they are motivated to contribute when the facilitator inspires them to contribute, and 66% of students agree that the students are motivated to contribute when the facilitator summarizes what had been discussed (Hew et al., 2010).

<center>**Constructivism**</center>

Constructivism is meaningful as a conceptual framework for online learning with online discussion. Generally, constructivists believe that knowledge is constitutive of the world, not about the world (Sherman, 1995). In this case, knowledge is not fixed; it is constructed by personal experience. Learning is an active process which is related to the building of current

knowledge and experience to form objects and new information (Lambert & Walker, 1995). In other words, meaningful learning takes place when learners think and construct their own knowledge actively and creatively based on prior knowledge and experience. The approach of constructivists to learning and teaching is based on a combination between cognitive psychology and social psychology, just as behavior modification techniques are based on behavioral psychology (Huitt, 2003). Kearsley (1994) is one educator who has clarified the principles for constructivist learning. Instruction should be related to contexts that help students act and learn enthusiastically as well as experientially. In addition, instruction should be well-organized so that students can understand easily. Instruction should also be considered to promote extrapolation. In summary, from a constructivist perspective, contexts to attract active and voluntary participation from students, well-organized structure for students' easy understanding, and inference or estimation by extending known knowledge should be considered in online learning.

Cognitive Constructivism

Piaget (1953), one of the founders of cognitive constructivism, focused on individual constructivism and studied how learners construct and interpret their knowledge individually. "Cognitive constructivism will focus more on facts and constructing knowledge within one's own schemas" (Powell & Kalina, 2009, p. 246). Piaget used the notions of assimilation, accommodation, and equilibration to explain cognitive constructivism. Assimilation occurs when learners assimilate new knowledge in their own schemas and accommodation occurs when learners change their existing schema for adaptation of new knowledge. Equilibration takes place when learners resolve conflicts in cognition through processes of assimilation and accommodation. "Piaget's cognitive constructivism theory incorporates the importance of

understanding what each individual needs to get knowledge and learn at his or her own pace" (Powell & Kalina, 2009, p. 243).

The independence of distance learning is associated with cognitive constructivism. For example, "Wedemeyer emphasized learner independence and adoption of technology as a way to implement that independence" (Tracey & Richey, 2005, p. 20). Wedemeyer stated that a teacher, learners, communication system and contents should be reorganized for the freedom of learners independently in distance learning. Furthermore, Savenye (2005) stated that more independent and self-motivated students are likely to be successful compared with students who are more dependent and less self-motivated. Greater freedom for learners stimulates them to apply the notions of assimilation, accommodation, and equilibration in distance education settings. In other words, learners construct their new knowledge based on their prior knowledge and experiences independently.

Traditional classroom settings can lead teachers to be active and students to be passive, but learners have an especially high responsibility for their learning in a distance learning circumstance because of the physical gap between learners and an instructor (Moore, 1994). Moore (1994) divided distance learning programs into autonomous programs, which are learner-centered, and non-autonomous programs, which are teacher-centered. Autonomous programs in distance education induce learners to assimilate, accommodate and equilibrate their schema and knowledge in their own ways with minimal assistance from the instructor.

Social Constructivism

Social constructivism is another important conceptual framework used to explain social interaction among learners in online discussion. Social constructivism is an effective teaching

method related to social interaction and collaborative work with students (Powell & Kalina, 2009). Lev Vygotsky is especially well known as one of the proponents of social constructivism. In particular, Vygotsky wrote about cognitive development based on the zone of proximal development (ZPD). "ZPD has been described as a zone where learning occurs when a child is helped in learning a concept in the classroom" (Powell & Kalina, 2009, p. 244). Children can learn easily within the zone when they have a relationship with others through social interaction and collaborative work. If kids attain their initial goals, they can do more within an extension of the zone. In addition, children try to learn and understand using their own abilities and then they act on teachers' assistance (Powell & Kalina, 2009).

Moreover, Holmberg (1985) emphasized the importance of interaction and the relationship between the instructor and learners which leads to learners' pleasure and motivation in distance learning. Online discussion in distance learning especially helps learners to have interactions with the instructor and their peers based on social constructivism so that the learners can exchange ideas and knowledge with the instructor and their peers. "From a social constructivist perspective, online discussions create opportunities for students to construct meanings together and integrate new knowledge into their prior experiences" (Baran & Correia, 2009).

Interaction, which has been viewed as a significant factor by social constructivists, is intimately connected with Moore's (1989) transactional distance theory. Transactional distance theory points to the cognitive and perceptual space between an instructor and learners or the space between a learner and other learners by the separation of the instructor from the learners in distance learning (Moore & Kearsley, 1996, p. 200). Gorsky and Caspi (2005) reported that

transactional distance decreases as dialogue increases or the distance increases as dialogue decreases. This means that transactional distance will decrease if interaction between an instructor and learners or between a learner and peers increases. The perceptions of students are not positive if transactional distance between a learner and an instructor or between the learner and other learners is large (Steinman, 2007). It is important to decrease the transactional distance through interaction's augmentation for students' positive perceptions.

Moore (1989) presented three kinds of interaction in distance learning: interaction between learners and contents, interaction between learners and learners, and interaction between learners and an instructor. In terms of interaction between learners and contents, interaction with contents enables the learners to change their understanding and cognitive thinking. In terms of learner-to-instructor interaction, the interaction stimulates students' motivation and interests and encourages students to apply what they have learned in accordance with their educational levels. In terms of learner-to-learner' interaction, students have interaction with their peers by sharing their experience.

This interaction is related to scaffolding, which Vygotsky (1934/1962) presented. According to Vygotsky, scaffolding is an effective learning process which enables students to learn more to support the ZPD through the assistance of peers, adults, and teachers. In addition, students can learn and understand deeply through cooperative learning with teachers or other students (Powell & Kalina, 2009). Internalization, stated Vygotsky, occurs effectively when students have social interaction with others. When students work on projects or activities in a group, the internalization of knowledge can be represented differently according to their respective experiences (Powell & Kalina, 2009).

Relationship between the Use of Technology and Students' Achievement

Schacter (1999) reported that the relationship between the use of technology and students' achievement in a Milken Exchange research study was positive. In addition, Kulick (1994) stated that achievement of students with computer-based instruction across all levels from elementary to higher education is higher than the achievement of students who are without significant computer-based instruction. He also found that students who learn through computer-based instruction learn more in a short period of time. According to Sivin-Kachala's (1998) research, students in computer-based environments have positive performances in all major areas and in all levels from preschool to higher education. In addition, Lu (2001) stated that there is a statistically significant relationship between the frequencies of online discussion of learners and their performances.

"Students' comfort and familiarity with technology has also been found to affect student learning, in that students with more experience using technology and with positive attitude toward it perform better in a virtual learning environment" (Krentler & Willis-Flurry, 2005). The relationship between the use of technology and students' achievement is related to the degree of familiarity with technology. Research about the relationship between students' achievement and the frequency of online learning experiences as related to the familiarity of web-based learning technology is needed in distance learning.

In another study, Krentler and Willis-Flurry (2005) found that the use of technology of students had a significant influence on students' learning. In particular, they stated that students who used discussion boards frequently got better grades. In other words, the relationship between the use of discussion boards and students' achievement is absolutely positive. However,

they also found that there is no relationship between the degree of students' internet use and students' achievement.

Conclusion

In summary, this chapter provided a brief history and the current status of distance education so that the reader can better understand the stream of distance education. In addition, the chapter focused on interaction and online discussion. Interaction, online discussion and social constructivism are mutually associated and applied to investigate online discussion participation effectiveness of students and their motivation and interests in the methodology. The chapter also presented the relationship between the use of technology and students' achievement.

The development of wireless networking and computer hardware has helped lead students to shift from in-class room learning to distance learning. Even though distance learning has several disadvantages, distance learning settings are increasing since the benefits free students from time and space limitations while learning. As distance learning provides online discussion based on social learning as well as individual learning settings, students can improve their abilities and skills through the sharing of ideas and knowledge from their peers or instructor. In addition, they can improve high-order thinking and problem-solving skills using the principles of thesis-antithesis-synthesis by solving their opinion conflicts with their peers through online discussion.

The role of an online expert facilitator in social constructivism is very important because an online facilitator's unnecessary intervention is likely to hinder students' autonomy. Moreover, structure in distance learning that is too well-organized can negatively influence their social interactions. Students' motivation and interest improvement through social interaction in online

discussion on distance learning is closely relevant to the role of an instructor and facilitator as a

helper and the balance between structure, interactions, and autonomy in distance learning.

CHAPTER 3

METHODOLOGY

Chapter 3 discusses the methodology related to focus groups, participant selection, interview structure and questions, instrument, data analysis and validation.

Context

The subjects of this study were teacher education students who were preparing for the Praxis I math exam at Indiana State University. The Praxis I exam measures fundamental skills and understanding in mathematics, reading, and writing, and the math and reading exams are composed of only multiple-choice questions. "The tests are designed to evaluate whether you have the academic skills needed to prepare for a career in education" (Educational Testing Service, 2011, p. 1). Some students who are preparing for the Praxis I math exam feel it is difficult to understand and solve word problems in mathematics because of the problematic translation from natural language to math language in word problems (Ilany & Margolin, 2010).

An investigation of the effect of online discussion on teacher education student, who must solve mathematical word problems in the Praxis I is meaningful. The important issue is how social interaction among students or between students and a facilitator in online discussion can influence students' motivation and interests in solving mathematical word problems.

Research Questions

In this study, the following research questions were identified:

1. How do teacher education college students who need remediation behave in online discussion board in mathematics?

2. What are the students' motivation and interest after they participate in the online discussion board in mathematics?

3. What are advantages and disadvantages of participation in the online discussion for remediation from the point of view of the students in mathematics?

4. To what extent does an expert facilitator impact the online remediation?

Research Materials

I created the online discussion board used in the study in a Moodle setting. The online discussion board was designed using just one frame style. When a user clicked a menu bar with the mouse, a webpage related to the menu bar appeared in the maximized windows like the screen capture below (Figure 1 & Figure 2). Figure 1 shows the main front page, which links to all pages in one frame. Figure 2 shows a subpage inside the main page in a maximized window. Topics in the online discussion board were based on mathematics word problems. The topics were created by the researcher by referring to the book, *Beginning and Intermediate Algebra* (Martin-Gay, 2008), the Northstar Learning System website which encourages students to improve scores on licensing exams and the Praxis I Pre-Professional Skills Math Test. The discussion topics consisted of five questions that were thoroughly reviewed by Dr. Marilyn Leinenbach, Associate Professor, Department of Elementary, Early, and Special Education, Indiana State University. The five questions consisted of two easy-level questions, one

intermediate-level question, and two advanced-level questions. The discussion topics were

posted at the beginning of online discussion participation. When participants accessed the

discussion board in the Moodle setting, they read the discussion topics, replied to posted topics,

replied to posted peers' or a facilitator's messages and posted new messages.
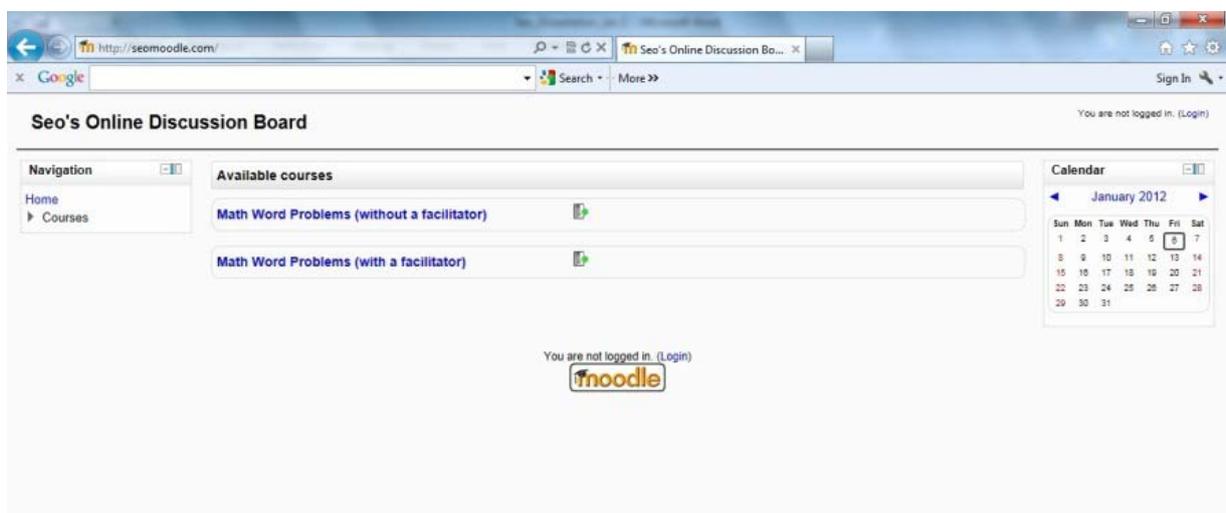
Figure 1. One frame style's main front page in the online learning program
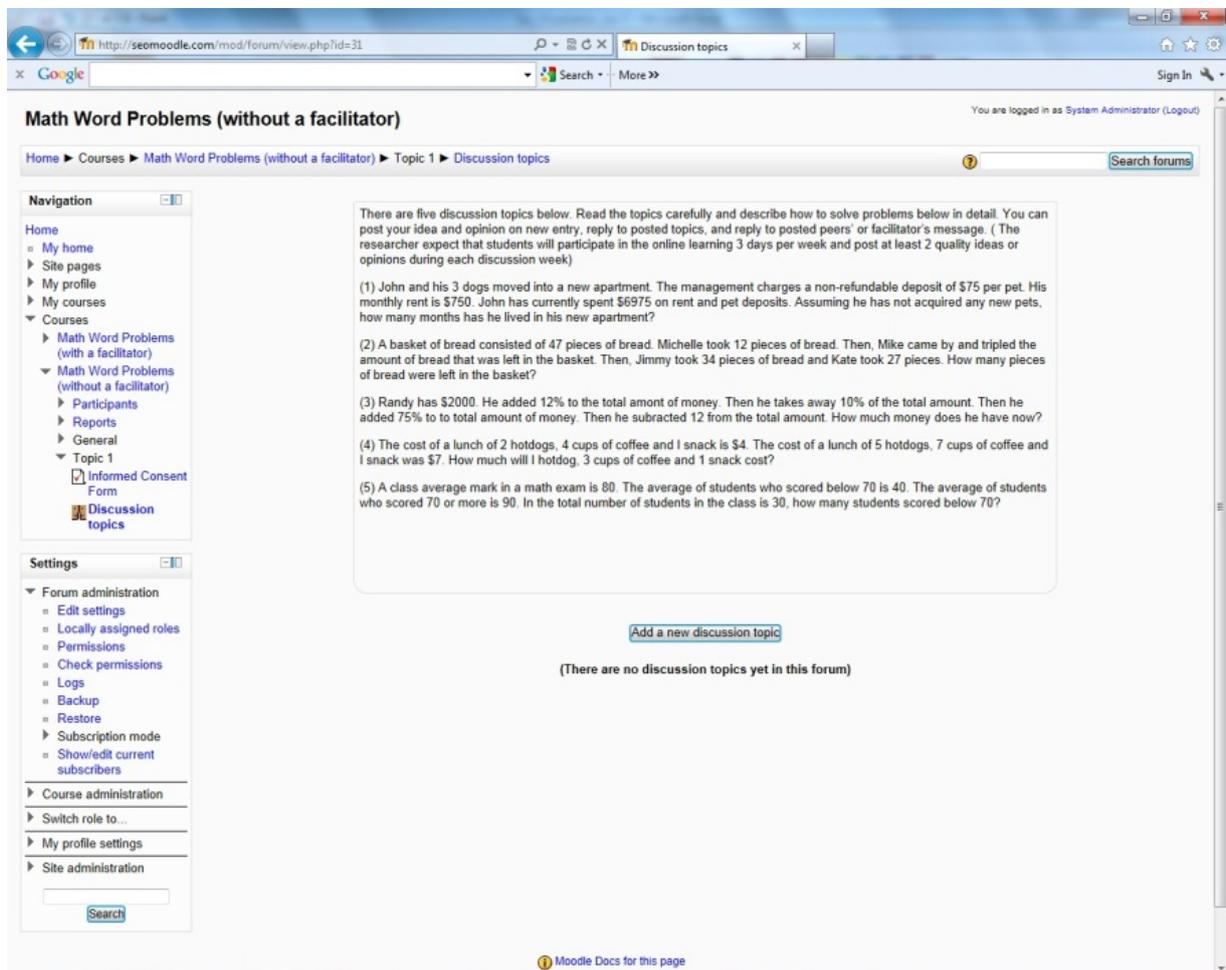
Figure 2. One frame style's subpage in the online learning program

Research Design

The purpose of the research was to investigate the participation of online discussion of teacher education students who are preparing for the Praxis I math exam. The target population of this research study was a specific group that was not familiar with online learning research. Although the data collected in the study were not generalized to the entire population of teacher education students, they provided good insight into a small population of teacher education

students who are preparing for the Praxis I math exam. The study was designed to provide a broader understanding about a specific group of students whose understanding of online education is different than that of the entire population.

Participants

As participants in this study, 12 teacher education students who were preparing for the Praxis I math exam were invited to participate through the Office of Education Student Service at Indiana State University. Students in one group participated in the discussion board without a facilitator and students in the other group participated in the discussion board with a facilitator. The requirements to participate in the study were

- all interviewees had to be teacher education students, and

- all interviewees had to be students who were preparing for the Praxis I exam.

Instrument

The instrument that was used in the research was a modified form created by Edelstein and Edwards (2005; see Appendix A) used for assessing the effectiveness of students' participation in online discussion. After I observed students' participation in online discussion, I qualitatively analyzed the students' participation records, which were saved in an online discussion board according to a rubric instrument.

Procedures

The study took place during the spring, summer, and fall semesters of 2012. The procedures for implementation are shown in Table 1. Prior to conducting the study, the director of Education Student Services at Indiana State University was contacted and given a verbal and written explanation of this study. An email requesting permission to conduct this study was also

sent to the director of Education Student Services, and I received the director's consent. The student assistant was selected as an expert facilitator in the online discussion forum. She was a graduate student in Curriculum, Instruction, and Media Technology and her master's degree was in mathematics. In addition, the moderator was selected in the asynchronous virtual focus group interviews. She was a graduate student in nursing education and had experience as a moderator in discussion groups. I explained their roles in the online discussion board to the online facilitator or the asynchronous virtual focus group interviews to the moderator.

Prior preparation. During the 2012 spring, summer, and fall semesters, students who participated in the online discussion were recruited with the assistance and under the guidelines of Dr. Judy Sheese, the director of Education Student Services. Upon recruitment, an orientation document was emailed to participants. The orientation was composed of an introduction of me, description of the online discussion and the research, and instructions on how to participate in the online discussion.

Consent form. Online informed consent forms were given to the participants so that they could read and sign by clicking *I Agree*. The forms were collected by me in a Moodle setting.

Table 1

Timetable of Procedures for Implementation

Dates	Duration	Tasks
April 1 – April 15	2 weeks	Prior preparation
April 20 – April 22	3 days	Online consent form for Group A without a facilitator
April 23 – April 30	1 week	Students' participation in online discussion board (Group A)
May 18 – May 20	3 days	Online consent form for Group B without a facilitator
May 21 – May 27	1 week	Students' participation in online discussion board (Group B)
May 28	1 day	Asynchronous virtual focus group discussion in Group A & B combined without a facilitator
Sep 28 - Sep 30	3 days	Online consent form for Group C without a facilitator
Sep 28 - Sep 30	3 days	Online consent form for Group D with a facilitator
Oct 1 – Oct 8	1 week	Students' participation in online discussion board (Group C)
Oct 1 – Oct 8	1 week	Students' participation in online discussion board (Group D)
Oct 9	1 day	Asynchronous virtual focus group discussion in Group C without a facilitator
Oct 9 – Oct 12	4 days	Asynchronous virtual focus group discussion in Group D with a facilitator
Oct 13	1 day	Asynchronous virtual interview with the facilitator

Participation in online discussion board. I posted the discussion topics on the online discussion board (see Appendix B). During one week, participants joined the online discussion board in order to discuss the topics. The participants were divided into two groups, a group with an expert facilitator and a group without an expert facilitator in the online discussion board. The participants in a group without an expert facilitator actively read posted discussion topics, replied to posted topics, replied to posted peers' message, and posted new messages. The participants in the group with an expert facilitator actively replied to the facilitator's message as well as read posted discussion topics, replied to posted topics, replied to posted peers' message, and posted new messages. All participants were grouped as Group A, B, C, and D according to chronological order. I conveniently assigned the participants into small groups several times since many students did not participate in the online discussion board at the same time when Irecruited the participants. Groups A, B, and C belonged to groups without an expert facilitator in the online discussion forum and Group D belonged to the group with an expert facilitator. I observed participants' behavior on the Moodle setting in Groups A, B, C, and D.

Asynchronous virtual focus group interviews. Asynchronous virtual focus group interviews were selected for the exploratory studies. A focus group interview is a discussion with a group of people who have specific attributes in order to obtain qualitative data related to a research purpose (Cheng, 2007). The interviews were conducted with open-ended questions and semi-constructed conversation with the students. All asynchronous virtual focus group interviews were carried out on the Moodle setting. Keeping in mind Cheng's (2007) recommendation that "the optimal size for a focus group is between 6 and 10 participants" (p. 195), the study had two focus groups.

The moderator introduced topics for discussion and gave interview questions to the participants for discussion. The asynchronous virtual focus group interviews simultaneously were carried out and saved in the Moodle setting. Each interview was one to four days in duration because of asynchronous virtual interviews. The participants posted their opinions for the focus group interview without time and space limitations.

Interview questions.

1. How did you interact with the online discussion board on a Moodle setting? (ex: did you post your new ideas only? Or did you reply peer's idea or opinion only?)

2. Did you enjoy the activities provided in the discussion board? (If *yes*, how did you enjoy it? If *no*, why did not you enjoy it?)

3. What are some things that you especially liked about the online discussion?

4. What are some things that you especially disliked about the online discussion?

5. Do you think that the online discussion of the online learning program is effective for the remediation? Why? Or why not?

6. What are advantages of participation in online discussion for remediation in mathematics?

7. What are disadvantages of participation in online discussion for remediation in mathematics?

Interview structure. In order to accomplish the research goal, a semi-formal interview structure was used. According to Morgan (1997), less structured interviews enable participants to tell their stories freely in a comfortable environment. In addition, only seven questions were designed so that students could participate in discussion broadly and deeply.

Data collection. The students' participation records, which were saved in the online discussion board, were collected on the Moodle setting by me.

Data analysis. When the data were collected, the content of the virtual focus group interviews was analyzed qualitatively. I employed the use of transcription and coding and created themes to organize all the data in order to get findings. The first step in the analysis of the data was transcription. All interviews were saved in the Moodle setting. After they were all transcribed, all the text was coded and assigned themes. Detailed analysis with a coding process was started using the Nvivo 9 software. During the coding process, description about setting, people, and themes for analysis were generated. Themes which emerged from the data were analyzed by narrative analysis.

The students' participation records, which were saved in the online discussion board, were transcribed and analyzed according to rubric on the instrument for assessing the effectiveness of students' participation in online discussion. I qualitatively assessed the effectiveness as "drifting," "moving in the right direction," "valuable performance," and "our goal" on categories of "contribution to the learning community," "relevance of post," "expression within the post," and "promptness of initiative."

When students did not make an effort to participate in the learning community in the category of "contribution to the learning community" on the rubric, this was recorded as "drifting." When the students occasionally made meaningful reflection on the group's efforts, it was recorded as "moving in the right direction." When the students often made reflections that become central to the discussion for the group, it was recorded as "valuable performance." When

the students presented logical and creative reflections on discussion topic which prompted further discussion, it was recorded as "our goal."

In the case of "relevance of post," when the students posted topics which did not relate to the discussion content, it was recorded as "drifting." When the students occasionally posted off topic or the comments did not offer further insight into the discussion topics, it was remarked as "moving in the right direction." When the students posted their opinions related to discussion topic, it was recorded as "valuable performance." When the students consistently posted their opinions related to discussion topics and additional references, it was recorded as "our goal."

In the case of "expression within the post," when the students did not express their opinion clearly, it was recorded as "drifting." When the students had minimal expressions of their opinions or ideas even though they had an unclear connection to the discussion topics, it was commented as "moving in the right direction." When the students stated their opinions or ideas clearly with occasional lack of connection to the discussion topics, it was recorded as "valuable performance." When the students expressed their opinions or ideas clearly with obvious connection to the discussion topics, it was recorded as "our goal."

In the case of "promptness of initiative," when the students did not respond to most comments, it was recorded as "drifting." When the students responded to most comments several days after other students initially posted, it was recorded as "moving in the right direction." When the students responded promptly to most comments, it was recorded as "valuable performance." When the students responded promptly to most postings and demonstrated excellent self-initiative, it was recorded as "our goal."

The Researcher

I am a Ph.D candidate majoring in Curriculum and Instruction, at Indiana State University who has completed coursework on research methods. My bachelor's degree was in Math Education, and my master's degree was in math and computer science. Prior to the study, I had eight years of math and information technology teaching experience with middle, high, and college students as well as with soldiers.

Confidentiality

All data related to online discussion were collected in a Moodle setting. I assigned pseudo usernames and passwords to all participants, so the Moodle setting protected participants' confidentiality through an encryption algorithm. The students' participation records, which were saved in the online discussion board, were collected in the Moodle setting.

To ensure confidentiality in the case of the asynchronous virtual focus group interview, all records were saved in the Moodle settings protected by an encryption algorithm. During the process of transcription and coding, all names were modified. After the data analysis, all names were removed and not published with the results of the study.

Validity

To ensure the validity of the findings, triangulation was used in the research. Triangulation is related to the consistency of different data sources (Patton, 2001) and to the comparison between observations with interview or between interviews and other written evidence within qualitative methods. A comprehensive qualitative method combining an analysis of transcription from the students' participation records in the online discussion board, an analysis of transcription and asynchronous virtual focus group interviews, and an analysis of the

asynchronous virtual interview with the facilitator in the online discussion board were used for

triangulation of the data sources in this study.

CHAPTER 4

RESULTS

The purpose of the study was to investigate the behavior, motivation, and interest of teacher education students who participate in remedial mathematics through an online discussion as well as the benefits and drawbacks of online discussion board participation and the effect of an expert facilitator in the online discussion. The participants were divided into two groups: a group with an expert facilitator and a group without an expert facilitator in the online discussion board. Groups A, B, and C were assigned groups without an expert facilitator, and Group D was assigned as a group with an expert facilitator. Students participated in the online discussion board for a week. After completing their participation in the online discussion board, students participated in asynchronous virtual focus group interviews based upon their respective experimental groups. The qualitative data for seven interview questions were coded using the Nvivo 9 qualitative software. The results of those interviews were analyzed qualitatively and themes from the narrative analysis were classified into several themes according to the research questions (Bogdan & Biklen, 2007). The students' participation records, which were saved in the online discussion board, were transcribed and analyzed according to a rubric using an instrument for assessing the effectiveness of students' participation in online discussion. I qualitatively

assessed the effectiveness as "drifting," "moving in the right direction," "valuable performance," and "our goal" for the categories of "contribution to the learning community," "relevance of post," "expression within the post," and "promptness of initiative."

Participation in the Online Discussion Board

Participants and Grouping

Table 2 reports the dates, tasks, and number of participants for students' participation in the online discussion board and asynchronous virtual focus group interviews for each group.

Data analysis for the first and second discussion topic (easy level questions): Assessing effectiveness of student participation in groups with or without a facilitator. The records of participation for six students who answered the easy level questions (the first and second discussion topic) in Groups A, B, and C were analyzed. The records of participation for four students who answered the easy level questions (the first and second discussion topic) in Group D were also analyzed. Table 3 shows the results of assessing the effectiveness of student participation in groups with and without a facilitator. I analyzed the students' participation records according to a modified rubric instrument which was created by Edelstein and Edwards (2002; see Appendix B).

Data analysis of the third discussion topic (intermediate level questions): Assessing effectiveness of student participation in groups with or without a facilitator. The records of participation for six students who answered the intermediate level questions (the third discussion topic) in Groups A, B, and C were also analyzed. In addition, the records of participation for four students who answered the intermediate level questions (the third

discussion topic) in Group D were analyzed. Table 4 shows the results of assessing the

effectiveness of student participation in groups with and without a facilitator.

Table 2

Report of Dates, Task, and Number of Participations

Dates	Task	Number of Participants
April 23 – April 30	Students' participation in discussion board for Group A without a facilitator	3
May 21 – May 27	Students' participation in discussion board for Group B without a facilitator	3
May 28	Asynchronous virtual focus group discussion in Group A & B combined without a facilitator	2 out of 6
Oct 1 – Oct 8	Students' participation in discussion board for Group C without a facilitator	2
Oct 1 – Oct 8	Students' participation in discussion board for Group D with a facilitator	4
Oct 9	Asynchronous virtual individual interview in Group C without a facilitator	1 out of 2
Oct 9 – Oct 12	Asynchronous virtual focus group discussion in Group D with a facilitator	3 out of 4
Oct 13	Asynchronous virtual interview with the facilitator	1

Table 3

Results of Assessing Effectiveness of Student Participation in Groups A, B, and C combined

without a Facilitator or in Group D with a Facilitator (Easy Level Questions)

Category	Description of the Group without a Facilitator	Description of the Group with a Facilitator
Contribution to the Learning Community	Valuable Performance	Valuable Performance
Relevance of Post	Our Goal	Our Goal
Expression within the Post	Valuable Performance	Valuable Performance
Promptness of Initiative	Valuable Performance	Moving in the Right Direction

Table 4

Results of Assessing Effectiveness of Student Participation in Groups A, B, and C combined

without a Facilitator or in Group D with a Facilitator (Intermediate Level Questions)

Category	Description of the Group without a Facilitator	Description of the Group with a Facilitator
Contribution to the Learning Community	Moving in the Right Direction	Valuable Performance
Relevance of Post	Valuable Performance	Valuable Performance
Expression within the Post	Valuable Performance	Valuable Performance
Promptness of Initiative	Moving in the Right Direction	Moving in the Right Direction

Data analysis of the fourth and fifth discussion topic (advanced level questions):

Assessing effectiveness of student participation in groups without a facilitator. The records

of participation for six students who answered the advanced level questions (the fourth and fifth

discussion topics) in Groups A, B, and C were analyzed as well as the records of participation for

four students who answered the advanced level questions (the fourth and fifth discussion topics)

in Group D. Table 5 shows the results of assessing the effectiveness of student participation in

groups with and without a facilitator.

Table 5

Results of Assessing Effectiveness of Student Participation in Groups A, B and C combined

without a Facilitator or in Group D without a Facilitator (Advanced Level Questions)

Category	Description of the Group without a Facilitator	Description of the Group with a Facilitator
Contribution to the Learning Community	Drifting	Valuable Performance
Relevance of Post	Moving in the Right Direction	Valuable Performance
Expression within the Post	Moving in the Right Direction	Valuable Performance
Promptness of Initiative	Moving in the Right Direction	Moving in the Right Direction

Results from Qualitative Data Analysis

The first focus group interview question was "How did you interact with the online

discussion board on a Moodle setting?" In analyzing the data, themes that emerged were (a)

posting of new ideas, (b) replying to peers' comments, and (c) the difficulty to deal with hard

questions. To illustrate the themes, I found that all participants from the group without a

facilitator reported that they posted their new ideas and replied to their peer's opinion to share their ideas on a Moodle setting. One participant from the group without a facilitator remarked, "I tried to interact with the online discussion board and posted my ideas on all discussion topics and replied to other's opinion." Another participant from the group stated, "I have tried to share my opinions through posting my ideas." Similar results were investigated for the group with a facilitator. Participants from this group reported that they also posted their ideas and replied to several comments from their peers. A participant from the group remarked, "When interacting with the online discussion, I first read the question that I was expected to respond to. Once I posted the solution, I looked at the posts by other students." Another participant from the group stated, "When I saw the post, I focused on the questions to solve by myself through posting."

However, participants from the group with a facilitator (33%) and without a facilitator (33%) answered that it was difficult when they faced hard questions. One participant from the group without a facilitator stated, "I felt frustrated when I dealt with difficult questions." One participant from the group with a facilitator remarked, "It was difficult for me to have good idea when I faced hard questions." One participant from the group with a facilitator reported that she used the posts from other students and the suggestions from a facilitator when she tried to answer questions. She remarked, "If I could not figure out the answers, I looked at the posts by other students. When I could not figure out a problem, I tried to use the suggestions that the facilitator suggested in response to my post."

The second focus group interview question was "Did you enjoy the activities provided in the discussion board?" In analyzing the data, themes that emerged were (a) enjoyable and (b) not enjoyable. To illustrate the themes, I found that most participants from the group without a

facilitator (100%) and with a facilitator (66%) reported that they enjoyed the activities that involved solving problems in the discussion board. One participant from the group with a facilitator remarked, "I enjoyed solving five math problems because I could solve questions without hint." Another participant from the group stated, "I enjoyed the activities and tried to share my idea with my peers and the facilitator." One participant from the group without a facilitator said, "I enjoyed the activities provided in the discussion board since my peer's opinion helped me develop critical thinking skills." Another participant from the group stated, "I enjoyed solving the problem and typing it in the board." Participants from the groups with a facilitator (33%) and without a facilitator (33%) reported that their peers' or facilitator's comments helped them approach the right answer. One participant from the group with a facilitator stated, "The facilitator's comment as well as peers' opinions helped me to approach the right answer." One participant from the group without a facilitator remarked, "My peer's opinion helped me develop critical thinking skills to lead to the right answers. The more difficult it is to get the right answer, the more useful it is."

Participants from the groups with a facilitator (33%) and without a facilitator (66%) reported that the difficulty of questions, the difficulty of following others' comments on the discussion forum, or unclear peers' opinions prohibited them from enjoying the process of solving problems. One participant from the group with a facilitator remarked, "The last two problems were very difficult and I got frustrated, making me want to give up." One participant from the group without a facilitator stated, "It was not easy for me to read and follow others opinion using the board." Another participant from the group said, "Just a few comments from peers did not give me a lot of clues for solving the problems."

The third focus group interview question was "What are some things that you especially liked about the online discussion?" In analyzing the data, themes that emerged were (a) no space and time limitations, (b) flexibility, and (c) social interaction. Most participants from the groups with a facilitator (66%) and without a facilitator (100%) reported that they liked the online discussion because there were no space and time limitations as well as the fact that they could save time. One participant from the group with a facilitator said, "I could gain experience using my computer and online discussion without a time restriction on mathematics." Another participant from the group remarked, "I participated in the discussion board without a space limit." One participant from the group without a facilitator stated, "I could engage in the matter outside of the classroom without space and time restriction." Another participant from the group said, "I like online discussion because there is no a space and time limit."

Participants from the group without a facilitator (33%) reported that participants liked the flexibility and relevance of the online discussion. One participant from the group stated, "The online discussion has advantages like flexibility, relevance, and saving time." Participants from the groups with a facilitator (66%) and without a facilitator (33%) reported that they liked the social interaction between students in the discussion board. One participant from the group with a facilitator remarked, "I also liked the interactive format of the discussions." Another participant stated, "The online discussion can facilitate participants to improve critical thinking skills though social interaction. Collaborative learning with peers and the facilitator is very effective." One participant from the group without a facilitator remarked, "Participants can share their opinions on the Moodle setting and discuss openly." In addition, the facilitator said, "The main advantage

of online discussion is to allow participants to join anytime and anywhere at their convenience and to reflect upon their thinking prior to posting to make sure they are on the right track."

The fourth focus group interview question was "What are some things that you especially disliked about the online discussion?" In analyzing the data, themes which emerged were (a) time lag problems, (b) non-thread forum, (c) unfamiliar interface, and (d) plagiarism of others' ideas and opinions. Most participants from the groups with a facilitator (66%) and without a facilitator (66%) reported that they disliked the time lag problems in the online discussion board. One participant from the group with a facilitator remarked, "I would have benefited more from face-to-face instruction in this case because of a time lag on the online discussion forum." One participant from the group without a facilitator stated, "There are serious time lag problems." Another participant from the group said, "It has several limitations such time lag and only text-based settings." Participants from the groups with a facilitator (33%) and without a facilitator (66%) reported that the non-thread forum made them feel uncomfortable. One participant from the group with a facilitator remarked, "Sometimes participants feel frustrated in non-threaded structure." One participant from the group without a facilitator said, "Participants can feel confused in non-threaded forums." Another participant from the group stated, "I dislike time-consuming work to read all comments in a complicated non-thread."

Participants from the groups with a facilitator (33%) and without a facilitator (66%) reported that the unfamiliar interface made them feel uncomfortable. One participant from the group with a facilitator said, "I also was not familiar with the website used for this discussion. I would have had an easier time completing these discussions if they were more familiar with it." One participant from the group without a facilitator remarked, "The textbox was small. I couldn't

see what I wrote above, which made it difficult to continue writing down the solution." Another participant from the group stated, "Only text-based settings were inconvenient for me." Participants from the group with a facilitator (66%) reported that they disliked plagiarism of others' ideas and opinions. One participant from the group with a facilitator said, "Some student might just copy what other students did without actually attempting the problem on their own first." Another participant remarked, "It is possible for participants to copy or modify the facilitator and peer's opinion."

The fifth focus group interview question was "Do you think that the online discussion of the online program is effective for remediation?" In analyzing the data, themes that emerged were (a) effective and (b) not-effective. Participants from the groups without a facilitator (66%) and with a facilitator (66%) reported that the online discussion was effective for the remediation because participants shared their opinions and ideas so that others could learn different ways to solve problems. One participant from the group with a facilitator said, "The online discussion can make accessibility and opportunities for interactions from more thoughtful and reflective responses." Another participant from the group remarked, "Sharing ideas in the online discussion forum can encourage participants to develop problem-solving and critical thinking skills." One participant from the group without a facilitator stated, "Participants can share their opinions and ideas. They catch the portion individuals do not know through collaborative learning." Another participant from the group remarked, "Many people can add their own ideas into the online board so that others can learn different way to solve one problem."

Moreover, participants from the groups without a facilitator (33%) and with a facilitator (33%) commented on ineffective aspects. One participant from the group with a facilitator stated,

"Participants did not like online discussion due to the limitation from online settings, the online discussion of the online program would not be effective." One participant from the group without a facilitator remarked, "It depended on students because I would benefit more from physical interaction with someone how could answer my question immediately and show me how to do a problem, rather than just explaining it to me." The participant also stated, "It is impossible to have feedback through immediate interaction between students due to a problem with time lag."

The sixth focus group interview question was "What are advantages of participation in online discussion for remediation in mathematics?" In analyzing the data, themes that emerged were (a) no space and time limitations, (b) collaboration and cooperation, (c) a reduction of pressure, and (d) the need of a facilitator. Participants from the groups with a facilitator (66%) and without a facilitator (33%) reported that no space and time restrictions are the main advantage of online discussion for remediation. One participant from the group with a facilitator remarked, "The advantages of the online research are that participants can work without space and time limitation." Another participant from the group stated, "A student could complete the tasks at a time that is best for them." One participant from the group without a facilitator remarked, "The main advantage of the online discussion board remediation is the fact that it is very convenient without space limitations." The facilitator said, "Participating in an online discussion for remediation in math allows participants to reflect and work anytime anywhere depending on their fundamental problem solving and critical thinking skills."

Participants from the groups with a facilitator (33%) and without a facilitator (66%) reported that collaborative and cooperative work is an advantage of online discussion. One

participant from the group with a facilitator stated, "It also allows the student to see how other students solved the problem in collaborative work while being completely confidential." One participant from the group without a facilitator remarked, "Sharing ideas in the online discussion board can facilitate participants to improve critical thinking in collaborative and cooperative environment." Participants from the groups with a facilitator (33%) and without a facilitator (66%) reported that a facilitator is needed for remediation. A participant from the group without a facilitator stated, "If a facilitator actively leads participation, it helps them to solve the problem for remediation through collaboration." A participant from the group with a facilitator remarked, "The online facilitator led the participants in discussions on the right track." Another participant from the group stated, "An expert facilitator should play a key role in all work related to unexpected events that occur in the online discussion board." The participant suggested that an expert facilitator is required so that discussion about topics is active. Participants from the group without a facilitator (33%) reported that online discussion board can decrease the pressures through face-to-face interaction. One participant from the group said, "Some students might feel hesitant to speak their opinions in the face-to-face environments, but feel comfortable in the online discussion board. They can post their idea after careful consideration because of the advantage of the asynchronous method." The facilitator said, "The online discussion can reduce the pressures from the instructor and encourages participants to communicate with their peers and the facilitator and also express their perceptions without hesitation."

The seventh focus group interview question was "What are disadvantages of participation in online discussion for remediation in mathematics? In analyzing the data, themes which emerged were (a) the difficulty of using mathematical notations and expression in online settings,

(b) a deviation of the focus, (c) complicated mathematics expressions and threads in the online discussion board, (d) problems related to asynchronous online discussion, and (e) problems related to problem solving skills. Participants from the group with a facilitator (66%) and without a facilitator (66%) reported that it is hard to show the mathematical notation and expression in the online discussion board. One participant from the group with a facilitator said, "It was also not easy to read and follow others' mathematical expression." Another participant from the group remarked, "It is difficult to show the mathematical notation, expression, or symbols in the text-based online discussion board." One participant from the group without a facilitator stated, "It was impossible to directly express myself even though I wanted to express a variety of mathematical notations in the online discussion board." Another participant from the group remarked, "An online discussion board should develop technologies to enable students to express a variety of mathematical notations in user-interface environments."

Participants from the groups with a facilitator (66%) and without a facilitator (33%) reported that the comments might deviate from the focus in some topics in mathematics. One participant from the group without a facilitator said, "A facilitator was needed to rectify the situation when the discussion deviated from the focus." Another participant from the group said, "If there is not a facilitator or instructor, those problems sometimes will be unsolved on the wrong track." One participant from the group without a facilitator stated, "Some students might not judge whether peers' opinions are on the right track if there is not an expert facilitator."

Participants from the groups with a facilitator (66%) reported that complicated threads are the main disadvantage of participation in online discussion for remediation in mathematics. A participant from the group stated, "Some participants who needed remediation might feel

confused about different opinions in complicated threads." Another participant from the group

remarked, "Many complicated threads are very confusing if participants are not familiar with

those threads in the online discussion board." Participants from the groups with a facilitator

(33%) and without a facilitator (66%) reported that there are several problems related to

asynchronous online discussion. A participant from the group with a facilitator explained, "There

was no book to look up possible solutions or instructions to solve the problem, students could

easy look at each other's answers, there is no face-to-face interaction between the instructor and

student, and students could easy be confused by unclear questions." She confessed that she

modified her ideas after referring to peers and the facilitator's opinion without in-depth critical

thinking. One participant from the group without a facilitator remarked, "I could not get any

reply immediately when I wanted to ask a facilitator about unclear questions due to

asynchronous online discussion. there was slow feedback due to time lag. Even when

participants needed information promptly, they couldn't obtain it right away." Another

participant from the group remarked, "I could not receive straight reply when I did not

understand the question."

Participants from the groups with a facilitator (66%) and without a facilitator (33%)

reported that there are problems related to problem solving. A participant from the group with a

facilitator was afraid of other students who disguised themselves as creative problem solvers

even though they modified peers' new ideas or mixed up peers' ideas and the facilitator's

opinion. He stated, "Participants can copy or modify peers' and the facilitator's ideas in problem-

solving." Another participant from the group pointed out two sides to problem-solving skills.

She remarked, "It is not certain whether that peers' or facilitator's ideas will encourage the

participants to improve problem solving skills or not." One participant from the group without a facilitator stated, "Some students make an effort to improve their problem solving skills after comparing their idea with others', but others try to copy or modify others' comments without their own thinking." The facilitator reported that if one of the students had the right solution posted initially, there was a fair chance that the students who are struggling might use that solution and modify it for their own discussion post. She stated, "This negates the whole purpose of online discussion for math remediation where students get facilitation to improve their problem solving skills and abilities."

Summary

This research aimed to investigate the behavior, motivation, and interest of teacher education students who need remediation in online discussion in mathematics as well as the benefits and drawbacks of online discussion board when teacher education students participate in online discussion for math remediation as well as the effect of an expert facilitator in online discussion. A qualitative method was used to examine the behavior, motivation, and interests of participants in the group without a facilitator and with a facilitator and the results of the qualitative data analysis were classified into several themes.

For the first focus group interview question, themes that emerged were related to the posting of new ideas, replying to peers' comments, and the difficulty of dealing with hard questions. For the second focus group interview question, some participants stated that they enjoyed the activities that involved solving the problems, and peers' or the facilitator's comments helped them to get the right answer. However, others pointed out the difficulty of the questions, the difficulty of following others' comments on the discussion forum, and unclear

peers' ideas, which kept participants from solving problem in an enjoyable manner. For the third focus group interview question, themes of no space and time limitation, flexibility, and social interaction emerged. For the fourth focus group interview question, time lag problems, the non-thread forum, an unfamiliar interface, and plagiarism of others' ideas and opinions were themes that emerged.

For the fifth focus group interview question, some participants stated that the online discussion was effective for the remediation because they could share their ideas and opinions in the online discussion forum, and it could encourage participants to develop problem-solving and critical thinking skills. For the sixth focus group interview question, themes of no space and time limitations, collaboration and cooperation, reducing the pressure, and the need for a facilitator emerged. For the seventh focus group interview question, themes that emerged were the difficulty of using mathematical notations and expressions in online settings, a deviation of the focus, complicated mathematics expressions and threads in the online discussion board, problems related to asynchronous online discussion, and problems related to problem-solving skills.

CHAPTER 5

SUMMARY, DISCUSSION, RECOMMENDATIONS, AND CONCLUSIONS

This chapter includes the summary, discussion, recommendations and conclusions of the research.

Summary of the Study

All data collected in the Moodle setting were analyzed using the qualitative analysis of coding. I compared codes and analyzed several themes according to each research question. The results of assessing the effectiveness of student participation in both groups show that the facilitator is very important in online discussion. The participants especially needed help from the facilitator when they encountered advanced-level questions. In the case of easy and intermediate-level questions, a qualitative difference between the group without a facilitator and with a facilitator was not found. However, in the case of advanced-level questions, the participants had valuable performance on rubrics related to the contribution to the learning community, relevance of posts, and expression within the posts on accessing the effectiveness of student participation when the facilitator intervened in the online discussion.

Qualitative Data Analysis

Table 6 provides a summary of the qualitative data analysis.

Table 6

Categories of Qualitative Data Analysis

Research Questions	Themes
Interaction with the online discussion board	Both: Post of new ideas and reply of peers' opinions With a facilitator: Use of the suggestions from the facilitator Without a facilitator: Difficulty about hard questions
The activities provided in the discussion board	Both: Enjoyment of the activities to solve the problems With a facilitator: Encouragement of participation to approach the right answer, difficulty of hard questions, and the method to incorporate math and technology Without a facilitator: Unhelpful comments from peers and difficulty of following peer's direction
Advantages of the online discussion	Both: No time and space limitations and improvement of critical thinking ability
Disadvantage of the online discussion	With a facilitator: Time lag and only text-based settings and unfamiliar interface Without a facilitator: Plagiarism of other's ideas and opinions
Effectiveness of the online discussion	Both: Sharing of ideas and opinions and development of problem solving skills through interaction With a facilitator: The dislike of technology such as the online discussion board and problem on the instructor's part Without a facilitator: A time lag problem
Advantage of participation in online discussion for remediation	Both: Need of a facilitator With a facilitator: Collaboration and cooperation and reducing the pressure
Disadvantage of participation in online discussion for remediation	Both: Difficulty of mathematical notation and expression, deviation of the focus and problem related to asynchronous online discussion With a facilitator: Complicated math expression and threads and problem related to problem-solving skills

Discussion

The study was carried out with a small sample of 12 volunteer participants and the duration was one week. As the study did not have a large sample of participants and the testing did not take place over a long time period, the study has a limitation which should be taken into account when considering themes. The general purpose of the research was to obtain an understanding of the behavior, motivation, and interest of teacher education students who need remediation in an online discussion in mathematics as well as the strong and weak points of the online discussion forum. In addition to this purpose, the research described the effect of an expert facilitator in online discussion. The results of the qualitative data showed that most participants generally felt online discussion was effective for remediation in mathematics even though the online discussion forum had several disadvantages compared with face-to-face discussion.

Interaction with the Online Discussion Board

Regardless of whether or not the group had a facilitator, participants from the group with the facilitator and without the facilitator interacted with the online discussion board in a Moodle setting. They all posted their new ideas and replied to peers' opinions. According to Beuchot and Bullen (2005), interaction is active when participants post their new ideas, and interaction is reactive when the participants reply to peers' opinions. However, both groups with a facilitator and without facilitator were not assessed as "our goal" on categories of "contribution to the learning community" from the results of assessing effectiveness of student participation in groups. This means that the time was short so they may not have had sufficient time to find or invest in the value they found in the online discussion.

The Activities in the Online Discussion Board

Most participants from both groups stated they enjoyed the activities aimed at solving the problems in the discussion board. Some of them stated they were satisfied with the learning through social interaction with peers and the facilitator in the online discussion board. In particular, they emphasized the importance of the online expert facilitator. A participant from the group with a facilitator remarked, "The facilitator's comment as well as peers' opinions helped me to approach the right answer." Another participant said, "A facilitator can encourage participation and facilitate interactivity using social techniques." The group with a facilitator were assessed as "valuable performance" comparing to the groups without a facilitator on categories of "contribution to the learning community", "relevance of post", and "expression within the post" from the results of assessing effectiveness of student participation in groups for advanced level questions. This means that contribution, relevance of post, expression within the post of students increased when a facilitator participated in the online discussion. According to Ryle and Cumming (2007), the motivation about studying is higher when students immediately get a reply from the facilitator. The facilitator has a significant role in ensuring that the students participate in "activities to encourage social presence and ongoing participation" (p. 9). However, a few participants stated that some comments from peers were not helpful and made them confused. For instance, one participant said, "Just a few comments from peers did not give me a lot of clues for solving the problems." As a result, some of the peers' opinions could help students improve their critical thinking skills by comparing them with their own, but other opinions sometimes enabled students to deviate from the right answers. The comments of a

facilitator led students to approach the right answers and encouraged them to distinguish the right approach and the wrong one from their peers.

Advantages of the Online Discussion

The online discussion was discovered to have the following advantages: (a) no space limitation, (b) no time limitation, (c) flexibility, and (d) improvement of critical thinking ability. Participants from both groups regarded the excess of space and time limitations as an important advantage of an online discussion forum. For instance, one participant said, "I participated in the online discussion forum without space and time limitations." Even if participants are located in a remote area from the onsite spot, they can still participate in the online discussion. In addition, they can save time and access the online discussion board whenever they want because they are free from time restrictions. One participant stated, "Freedom from time limitations results in an improvement of critical thinking and problem solving ability." Participants can have enough time to think and organize their ideas after referring to peers' or the facilitator's comments through social interaction. One participant remarked, "Collaborative learning with peers and the facilitator is very effective." As the method of the online discussion board is asynchronous, they can analyze complicated issues logically and critically from various perspectives without time limitations. One participant said, "The online discussion can facilitate participants to improve critical thinking skills with a time restriction." Asynchronous online discussion allows time for reflection and research and decreases the anxiety and stress of participation (Baglione & Nastanski, 2007).

Disadvantages of the Online Discussion

On the other hand, online discussion was found to have the following disadvantages: (a) a time lag, (b) only text-based settings, (c) unfamiliar interface, and (d) plagiarism of others' ideas and opinions. Participants pointed out a time lag as a big flaw of asynchronous online discussion board. For instance, one participant said, "There are serious time lag problems in online discussion." They sometimes looked forward to a peer's or the facilitator's prompt reply, but it was difficult for them to get the reply as quickly as they wanted. Moreover, because of the fact that participants are unable to see the facial expressions and gestures of others in online discussion, they must base their judgment of peers' and the facilitator's opinions only through text-based settings. One participant remarked, "I could not catch all expressions only through text-based settings." According to Baglione and Nastanski (2007), communication dynamics and body language are restricted in online discussion. Some participants who dislike technology feel the online discussion board interface is unfamiliar. This can even give participants severe stress. "When both staff and students have an inadequate understanding of technology, the use of computers and the use of technology may become unbalanced and undesirable" (Yu, 2009, p.9). In addition, some participants can copy and modify peers' and the facilitator's comments and post them posing as a problem solver instead of creating and posting their own ideas. For example, one participant said, "Some students might just copy what other students did without actually attempting the problem on their own first." This hinders the development of participants' critical and problem solving skills.

Effectiveness of Online Discussion for Remediation

The findings also showed several factors related to the effectiveness of online discussion for remediation. Participants from both groups stated that online discussion is very effective for remediation since sharing their opinions and ideas can help them solve problems from various perspectives. One participant said, "Online discussion can make accessibility and opportunities for interactions from owns more thoughtful and reflective responses." Participants solve problems in their own way, and they compare their own ideas with peers' or the facilitator's comments so that they get the best answer and process leading to the best answer. Also, they have social interaction with their peers or the facilitator so as to get the best answer. This social relationship enhances the improvement of problem solving and critical thinking skills for remediation. One participant remarked, "Sharing ideas in the online discussion forum can encourage participants to develop problem-solving and critical thinking skills." Students in online settings have more opportunities to improve in-depth relationships in comparison with in-class settings (McCarthy, Smith, & DeLuca, 2010).

However, it is not effective if a participant is not familiar with technology like the online discussion board. For example, one participant remarked, "The restrictions of online settings kept her from concentrating on solving problems." Comments in the online discussion board are intertwined in complicated threads, so participants might feel truly confused if they are not accustomed to the use of online discussion settings. One participant said, "I felt difficulty in using the website since I was not familiar with interface and complicated thread of the website used for this discussion." In addition, a time lag problem in asynchronous online discussion decreases the effectiveness of learning for remediation. It is impossible for students to get a

prompt reply whenever they want because of the nature of the asynchronous online discussion method. The waiting time can hinder the continuity of learning. One participant said, "I can not receive a straight reply whenever I need any information." The facilitator's ability to lead is an important factor of effectiveness in the online discussion board. Leadership skills can enable students to participate actively in the online discussion board and guide the students in the right direction. One participant from the group with a facilitator remarked, "A facilitator's comments encouraged participants to solve hard questions on basic rules."

Advantages of Participation in Online Discussion for Remediation in Mathematics

Participation in online discussion for remediation was shown to have the following advantages: (a) the need of a facilitator, (b) collaboration and cooperation, and (c) the reduction of pressure. Participants from both the groups with and without a facilitator emphasized the importance of the facilitator leading them in the right direction. One participant from the group with a facilitator said, "The online facilitator led the participants in discussions on the right track."

In particular, the groups with a facilitator were assessed as "valuable performance" comparing to the groups without a facilitator on categories of "contribution to the learning community," "relevance of post," and "expression within the post" from the results of assessing effectiveness of student participation in groups for advanced-level questions. In other words, the participants better presented reflections, posted the meaningful comments related to discussion topics, and clearly stated their opinions and ideas when participants had a facilitator in the online discussion board. In addition, it is difficult for some participants to distinguish the right answer from the wrong answer, so they need the guidance of a facilitator. Moreover, the role of the facilitator is very important in mediating differences of opinions when there is a conflict of

opinions of participants. Peer-to-peer interaction enhanced by a facilitator is very important and motivation can be fostered by the facilitator in learning communities (Ryle & Cumming, 2007).

Participants stated that they could help each other through a collaborative and cooperative learning process, especially when they were faced with difficult problems. Students can make up for their individual weak points in learning by sharing their ideas and opinions. They obtain new knowledge and information through synthesizing their basic solving and critical thinking abilities and peers' and the facilitator's comments. One participant said, "When I met advanced level problems, I tried to use others' or the facilitator's ideas and opinions." Moreover, online discussion can encourage students to express their perceptions without hesitation, even if students are introverted. Students who feel uncomfortable talking with classmates and an instructor in class can actively participate in online discussion without pressure. One participant remarked, "Online discussion made me comfortable in participation." According to Baglione and Nastanski (2007), the benefit of threaded discussion is related to "reducing participation anxiety for shy students" (p. 2).

Disadvantages of Participation in Online Discussion for Remediation in Mathematics

It was also determined that participation in online discussion for remediation had the following disadvantages: (a) the difficulty of using mathematical notations and expressions in online settings, (b) a deviation of the focus, (c) complicated math expressions and threads in the online discussion board, (d) problems related to asynchronous online discussion, and (e) problems related to problem-solving skills. Participants from both groups stated that it is difficult for users to perfectly express all mathematical notations in the online settings. This means limitations of online interface compared to paperwork in in-class settings. For instance, one

participant remarked, "It was also not easy to read and follow other's mathematical expressions." Participants from both groups pointed out deviation from the focus in online discussion as a drawback. Some comments from peers can deviate from the focus in some topics in mathematics, so the facilitator should mediate the opinions of participants. Participants from both groups emphasized the importance of the facilitator, who should adjust and organize participants' opinions and ideas. One participant from the group with a facilitator said, "A facilitator gave the participants clear and right direction to approach the answer." When a comment deviated from the focus of the topic, the facilitator's proper intervention is needed. A facilitator should provide "initiatives for community building" as well as right answers and feedback with examples (Nandi, Hamilton, & Harland, 2012).

Complicated math expressions and threads in the online discussion board made some participants feel uncomfortable. For instance, one participant said, "Some participants who needed remediation might feel confused about different opinions in complicated threads." If a lot of students participate in the online discussion forum, threads are more complicated. The mixed threads in the online discussion board might hinder concentration and clear acquisition in social learning. A participant remarked, "The facilitator can make it clear in a state of confusion in the online discussion board." Moreover, asynchronous online discussion is difficult for students who need remediation to reply or attempt to reply due to a time lag. In other words, participants often have to wait for a reply from the facilitator or their peers. Both groups with a facilitator and without a facilitator were assessed as "moving in the right direction" on the category of "promptness of initiative" from the results of assessing effectiveness of student participation in groups for advance level questions. In other words, participants from both groups did not

promptly respond to most postings. In addition, there is a possibility that some participants can copy or modify peer's ideas and opinions, and this obstructs the improvement of critical thinking and problem solving skills of the participants. One participant said, "Some students might just copy what others did without actually attempting the problem on their own first." Lurkers just read the comments from peers or the facilitator and incorporate others ideas and opinions when completing assignments (Nandi et al., 2012). They also might get the right answer easily instead of making an effort to expand the scope of their thinking for remediation. In this case, only a few students prepare more fully prior to the discussion of topics (Pena-Shaff et al., 2005). This also means a lot of students have the potential to copy or modify peer's ideas and opinions without in-depth thinking.

<div align="center">**Recommendations**</div>

Implications

This research was restricted to a small sample of 12 volunteer participants who were teacher education majors who needed remediation in online discussion in mathematics, and the duration of this research was one week. The findings therefore have a limitation when drawing conclusions due to the lack of a large sample of participants and a long time period. However, the results showed that the students sincerely participated in the online discussion board and the asynchronous virtual focus group interviews and clearly posted their opinions. For effective learning through online discussion, several implications should be considered.

For online developers. Online developers should solve problems related to the difficulty of mathematical notations and expressions. They should make user interface convenient so that users can easily write their mathematical notations and expressions in the online discussion

board. They should also study and create methods of easy, simple graphic user interface through items or graphics. In addition, they need to consider an online board design to decrease the transactional distance between learners and instructors in order to strengthen the communication relationship between them. The design of easy communication tools can be helpful for sharing ideas and opinions between instructors and learners.

For facilitators. Facilitators in the online discussion board should guide students to actively participate in online discussion and encourage the learners to work hard. In addition, the facilitator should lead students in the right direction when some are on the wrong track or the focus deviates from discussion topics. The facilitator should give clues and hints which can encourage students to have creative and critical thinking about problems instead of simple posting answers directly. The facilitator should read, clarify and analyze their postings carefully and prepare proper replies to them when participants post their opinions and ideas. Moreover, the facilitator should help participants receive prompt help from technicians when participants have technical problems with the online discussion board.

Further Research

Clear results were found in this study even though a small sample of students participated. However, the performance improvement of students for remediation was not investigated. Therefore, a long-term study including a larger sample of participants is needed for the broad study of online discussion. The change of motivation, perceptions, and interests of online discussion in participation of students should be carefully investigated when a facilitator participates in the online discussion board either actively or passively. Moreover, the

participation of students in asynchronous and synchronous online discussion should be examined and compared from a variety of perspectives.

Conclusion

A number of studies have examined both the advantages and disadvantages of online learning programs. However, this study focused on the participation of students for remediation in mathematics word problems on an online discussion board. The participants were divided into groups with and without a facilitator in this qualitative study. Teacher education students who needed remediation in mathematics participated in the online discussion board. Following that, asynchronous virtual focus group interviews were carried out. Even though the results have a limitation due to the small sample of participants, various results could be analyzed.

Participants from both groups posted their ideas and opinions and replied to others' comments through social interaction on the online discussion board. Generally, participants from both groups enjoyed the activities provided by the online discussion board, but some pointed out the drawback of unhelpful comments from some peers and the difficulty for users who do not like technology or enjoy the online discussion board. The participants mentioned that the online discussion had the advantages of freedom from time and space limitations and the improvement of their critical thinking and problem solving skills. However, the online discussion also had disadvantages of time lag, reliance on a totally text-based interface, and the increased possibility for plagiarism of others' ideas and opinions.

Most participants stated that the online discussion was effective since sharing ideas and opinions could improve their problem solving skills through social interaction. However, some of them remarked about the ineffective factors, such as the fact that asynchronous online

discussion method has the problem of a time lag and might not be effective if students who do not like technology participate in the online discussion board. Participants from both groups emphasized the importance of the facilitator leading them in the right direction. Participants from the group with a facilitator better presented reflections, posted the comments related to discussion topics, and expressed their opinions and ideas comparing to participants from the group without a facilitator. The advantages of participation in online discussion for remediation mentioned were collaboration and cooperation in online discussion and a reduction of the pressure of participation comparing to in-class settings. The disadvantages of participation in online discussion for remediation mentioned were the difficulty of using mathematical notations and expressions and a deviation of the focus in asynchronous online discussion settings.

Finally, it is important to note that this study took place over a period of just one week for online discussion in mathematics word problems, and a small sample of participants was used. For further study, it is recommended that a larger sample of participants in the online discussion board should be utilized and that a long term period study, such as a month or one semester, should be carried out. In addition, algebra and geometry sections in mathematics should be considered in addition to mathematical word problems in future studies.

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APPENDIX A: STUDENT PARTICIPATION RUBRIC

Category	1.Drifting	2.Moving in the Right Direction	3.Valuable Performance	4.Our Goal (with due allowance for finitude)
Contribution to the Learning Community	Does not make effort to participate in learning community as it develops; seems indifferent	Occasionally makes meaningful reflection on group's efforts; marginal effort to become involved with group	Often presents reflections that become central to the group's discussion; interacts freely and encourages others	Consistently presents creative reflections on topic; aware of needs of community; frequently prompts further discussion of topic
Relevance of Post	Posts topics which do not relate to the discussion content; make irrelevant remarks	Occasionally posts off topic; most posts offer no further insight into the topic	Posts are related to discussion topic; makes some connections with readings	Posts consistently are related to discussion topics; brings readings into discussion; cites additional references related to topics
Expression within the Post	Does not express opinions or ideas clearly; no connection to topic	Unclear connection to topic evidenced in minimal expression of opinions or ideas	Opinions and ideas are stately clearly with occasional lack of connection to topic	Expresses opinions and ideas in a clear and concise manner with obvious connection to topic
Promptness of Initiative	Does not respond to most postings; rarely participates freely	Responds to most postings several days after initial discussion; limited initiative	Responds promptly to most postings; requires occasional prompting to post	Responds promptly to postings; demonstrates good self-initiative

APPENDIX B: DISCUSSION TOPICS

Discussion topics

There are five discussion topics below. Read the topics carefully and describe how to solve problems below in detail. You can post your idea and opinion on new entry, reply to posted topics, and reply to posted peers' or facilitator's message.

- John and his 3 dogs moved into a new apartment. The management charges a non-refundable deposit of $75 per pet. His monthly rent is $750. John has currently spent $6975 on rent and pet deposits. Assuming he has not acquired any new pets, how many months has he lived in his new apartments? 9

- A basket of bread consisted of 47 pieces of bread. Michelle took 12 pieces of bread. Then, Mike came by and tripled the amount of bread that was left in the basket. Then, Jimmy took 34 pieces of bread and Kate took 27 pieces. How many pieces of bread were left in the basket? 44

- Randy has $2000. He added 12% to the total amount of money. Then he takes away 10% of the total amount. Then he added 75% to the total amount of money. Then he subtracted 12 from the total amount. How much money does he have now? 1500

- The cost of a lunch of 2 hotdogs, 4 cups of coffee and 1 snack is $4. The cost of a lunch of 5 hotdogs, 7 cups of coffee and 1 snack was $7. How much will 1 hotdog, 3 cups of coffee and 1 snack cost? 3

- A class average mark in a math exam is 80. The average of students who scored below 70 is 40. The average of students who scored 70 or more is 90. It the total number of students in the class is 30, how many students scored below 70? 6