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Tutors' Roles Depending on Problem-Solving Phases for Facilitating the Critical Thinking Ability in Online Learning

Seong Ik PARK Yoon-Jung KIM*

Seoul National University

Korea

Facilitating critical thinking is important for students' cognitive growth and knowledge acquisition. This study examines the dimensions of tutors' roles in facilitating the critical thinking required for problem solving in online discussions. The research procedures include identifying the research problems related to critical thinking skills; synthesizing theories and perspectives on critical thinking skills; and analyzing, validating, and determining tutors' roles. Using the results of this study, problem solving processes are divided into four phases: analyzing, judging, inferencing, and meta-cognitively evaluating. Tutors' roles in online problem solving can be categorized into four domains: cognitive, social, managerial, and technical. Tutors' roles in each domain are specifically analyzed, and the strengths, weaknesses, and improvements in tutors' facilitation of critical thinking for online problem solving are evaluated.

Keywords : Tutor's roles, Critical thinking, Problem solving, Online learning

* Department of Education, Seoul National University
bimay@hanmail.net

Introduction

The rapid development of technology has made a significant impact on how instruction on critical thinking is delivered. One of the educational system's fundamental objectives is the acquisition of knowledge and attitude related to critical thinking. Therefore, teachers must teach students to enhance their critical thinking skills during teaching and learning activities focused on problem solving. Teachers currently face challenges in designing innovative pedagogical approaches to promote critical thinking that produces valuable ideas and products. Problem solving through online discussions can offer "learning-in-relation" and "constructing knowledge cooperatively" simultaneously. Researchers emphasize that critical thinking cannot be separated from the learning context in which students engage in problem solving.

Facilitating critical thinking is important to support students' knowledge acquisition and cognitive abilities. Fly (1998) mentions that when an online tutor does not produce acceptable results, inadequate training on facilitating critical thinking is one of the main factors contributing to that failure. Kerr (2005) also insists that tutors' confidence and preparedness in facilitating critical thinking are one of the most influential elements affecting online learning outcomes. According to Sellers (2001), the tutor is no longer the 'dispenser of information'. The tutor becomes a facilitator. Instead of telling students the solution, the tutor asks questions to help them discover the answer themselves. Tutors need to allow students time to explore the material and to construct meaning from their problem solving experiences.

This study is to examine the dimensions and elements of tutors' roles and activities that facilitate critical thinking for problem solving in online discussions. Critical thinking can be used effectively during problem solving sessions in online discussion forums. The specific objectives of this study are to identify tutors' roles in each phase of problem solving geared toward critical thinking and to develop relevant strategies corresponding to each problem solving phase. Furthermore, some implications for critical thinking strategies used to enhance students' critical thinking skills for online

problem solving will be suggested.

Theoretical Backgrounds

Characteristics of Critical thinking

Critical thinking is that mode of thinking about any subject, content, or problem in which the thinker improves the quality of his or her thinking by skillfully taking charge of the structures inherent in thinking and imposing intellectual standards upon them (Michael and Richard, 1987). In addition, critical thinking is productive thinking in the pursuit of relevant and reliable knowledge about the world. Critical thinking is reasonable, reflective, responsible, and skillful thinking that is focused on deciding what to believe or what to do. Schafersman (1991) mentions that a person who thinks critically can ask proper questions, gather relevant information, and draw conclusions in an efficient, creative and trustworthy way.

Critical thinking can be taught through online discussion (MacKnight, 2000). However, in a study conducted with preservice teachers, the relatively low rate of critical thinking (16.7%) exhibited was a matter of concern (Hew & Cheung, 2003a). Although online discussion allows for giving and accepting feedback and for greater reflection, MacKnight (2000) states that online participants must be aware of the significance of their responses and must learn to ask good questions of themselves and others. Asking reasonable questions is the important skill. Questions that focus on the fundamentals of thought and reasoning form the baseline of critical thinking.

Equally important in the online discussion environment is the tutor's role in presenting questions that drive ideas and thus help students develop and apply critical thinking skills. To foster the students' critical thinking, tutors should play an important role while students learn through discussion.

Michael and Richard (1987) highlight four characteristics of critical thinkers: First,

well cultivated critical thinkers raise vital questions and problems, formulating them clearly and precisely. In addition, they gather and assess relevant information, using abstract ideas to interpret it effectively comes to well-reasoned conclusions and solutions, testing them against relevant criteria and standards. Furthermore, they think open-mindedly within alternative systems of thought, recognizing and assessing their assumptions, implications, and practical consequences as needed. Finally, they communicate effectively with others while figuring out solutions to complex problems.

Four Phases of Problem solving

According to both Gagné (1985) and Smith and Ragan (1999), learners involve a similar series of steps in problem solving no matter what the problem may be. While investigating the influences of an instructional method related to problem solving, Noh et al. (2001) proposed four steps of problem solving strategy: understanding, planning, solving, and checking. Ge and Land (2003) also suggested problem solving processes into four steps: representing problems, developing solutions, making justifications for generating or selecting solutions, and monitoring or evaluating the problem solutions. They commonly focused on analysis and judgment of the problem in the initial stage as well as evaluation of the problem in the final stage.

The problem solving phases are often associated with reasoned activities of critical thinking. According to Jacob and Sam (2008) critical thinking is another form of problem solving even though there are distinct differences between two concepts. Critical thinking contains reasoning processes about open ended or unstructured problems, whereas problem solving is usually considered in narrow views. Kurfis (1991) suggests that the common point between them is concrete enough to justify the problem solving processes for facilitating critical thinking. Critical thinking is a extensive process that contains justification and critical thinking ability is seen as a necessary condition for problem solving.

Paul and Elder (2005) state that critical thinking is a kind of process by which the learners improves their own thoughts by skillfully utilizing the thinking structure and imposing intellectual criteria upon them. The various aspects of critical thinking contribute to the various stages of problem solving. Garrison, Anderson, and Archer (2000) introduce the concept of a community of inquiry and suggested the importance of asynchronous communications on online for cognitive presence and as a tool for engaging in critical thinking. Garrison's practical inquiry model of critical thinking consists of four phases: triggers, exploration, integration and resolution. Perkins and Murphy (2006) developed a model to measure and report individual engagement in critical thinking in an online course. They suggest four phases, labeled clarification, assessment, inference, strategies. Especially, they focused on the online problem solving process in view of facilitating critical thinking.

Considering those phases of problem solving suggested above in connection to critical thinking, the four phases of problem solving in this study are identified as analyzing, judging, inferencing, and meta-cognitively evaluating.

Tutors' roles in facilitating critical thinking

A number of the tutor's roles are critical to facilitate critical thinking skills. For example, to facilitate effective online debate, the tutor must identify controversial topics, encourage and balance discussion on both sides, provide additional evidence and counter examples, and summarize and weave online discussion to raise debates to higher and more personally engaging levels.

Many studies have been performed to identify the roles of tutors in online problem solving. The four domains of a tutor's role in online learning are cognitive, social, managerial, and technical (Berge, 1995; Brochet, 1989; Mason, 1995; Goodyear, Salmon, & Spector, 2001). The tutor's role in each domain and descriptions of the tutor's roles are presented in Table 1.

Table 1. Tutor's roles in cognitive, social, managerial, and technical domains in online learning

Domains	Tutor's Roles	Description of Tutor's Roles
Cognitive domain	Designing courses	To design interactive learning experience To structure course materials To refine and update learning materials To share teaching experiences with colleagues
	Professional moderating	To promote professional dialogue among online learners To relate personal experiences and cases to the discipline To encourage professional organizations
	Providing feedback	To provide timely and high quality feedback To provide formative feedback for continuous learning engagement
	Facilitating interaction	To facilitate peer interaction in online discussion through a wide range of facilitation strategies
Managerial domain	Managing conference	To ensure equity in online discussion To provide rules and guidelines to augment online discussion To promote knowledge construction
	Organizing and Planning	To provide clear instructions and organization of course structure To achieve a balance between structure and flexibility
Social domain	Social rapport Building	To build social rapport To establish online teams To build online learning community
Technical domain	Technical coordinating	To provide students with technical support To communicate technical issues
	Media designing	To develop multi-media tools To identify and co-design efficient learning tool
	Technology Integrating	To use highly interactive tools to facilitate high quality online interaction

In the cognitive domain, a tutor contributes to online learners' understanding of course content as well as their development of critical thinking skills. The roles of online tutors in the cognitive domain revolve around facilitating educational processes for students' understanding of critical concepts, principles, and skills. Such tasks include encouraging students' knowledge-sharing and knowledge-building through interactive discussion, designing a variety of educational experiences, providing feedback, and referring to external resources or experts in the field.

The social roles of online tutors include developing harmony, group cohesion, and collective identity. This requires tutors to display nurturing skills by encouraging participation, giving ample feedback and reward, attending to individual concerns, and using a friendly personal tone. The tutors must be leaders in nurturing the community.

The managerial roles of online tutors involve the organizational, procedural, and administrative tasks associated with the learning environment. The tasks include coordinating assignments, managing online discussion forums, and handling overall course structure. Online tutors need strong leadership to accelerate online interaction by setting clear agendas and objectives for online conferences and establishing procedural rules and decision-making norms.

The technical role of online tutors can entail making participants comfortable with the system and software program used for online courses. Technical tasks include referring students to technical support resources, addressing technical concerns, diagnosing and clarifying problems, and allowing students sufficient time to learn new programs.

Comparative analysis of a tutor's roles suggested by researchers in online learning for facilitating the critical thinking

Brochet (1989) stresses moderation's importance to the success of computer conferencing and discusses six roles played by moderators: discriminator, explainer,

goal setter, host, pace setter, and entertainer. The unique point in Brochet's division is 'concreteness'. Online moderators even need to act as entertainers. He divides tutors' roles in a detailed way. In contrast, Mason (1991) identifies three functions that online moderators must address. These roles are organizational, social, and intellectual. In the organizational role, tutors set the agenda for learning: the objectives of the discussion, the timetable, procedural rules and decision-making norms. They manage interactions with strong leadership. Creating a social environment for learning is also seen as an essential moderator skill. The most important role of the online tutor, of course, is that of educational facilitator. In any kind of teaching, the moderator should focus discussions on crucial points, ask questions and probe responses to encourage students to expand and build on comments. Berge (1995) also provides a framework dividing the online tutor's roles into four categories: pedagogical, social, managerial, and technical. A variety of tasks are identified for developing the cognitive role of online learners, such as setting goals, self-monitoring, and evaluating, as well as identifying self-motivating factors and enabling participants' self-direction. Mason and Berge divided tutors' roles in a similar way. Mason's intellectual role corresponds to Berge's pedagogical role. Mason's organizational role corresponds to Berge's managerial role. The sole point of difference between two is the technical role. Their two frameworks show tutor's various activities beyond the cognitive role.

ARIS (2001) similarly identifies four domains, termed dialogue, involvement, support, and control, in which the role of the tutor or teacher is being redefined. The online tutor's tasks translate to "setting the scene, monitoring participation, facilitating critical thinking, and encouraging student collaboration" (Youngblood, Trede, & di Corpo, 2001). Furthermore, Goodyear, Salmon and Spector (2001) expand this list to describe the online tutor as process facilitator, advisor-counselor, assessor, researcher, content facilitator, technologist, and designer.

Davis and Roblyer (2005) also suggest several unique areas of competence that require experience with distance learning environments. First, course planning and organization strategies that capitalize on distance learning strengthen and minimize

constraints. In addition, verbal and nonverbal presentation skills must be tailored to distance learning situations. Moreover, effective courses can be produced through collaborative work with others. Distance tutors also need the ability to use questioning strategies as well as the ability to involve and coordinate student activities among several sites. They further state that many communication skills required of the online tutor are similar to those needed for effective classroom teaching. However, the online tutors' role requires a paradigm shift in online instruction management. Tutors need to make use of technologies and skills for communication between instructors, learners and contents (Therese, 2006).

The Penn State Learning Design Community Hub (2008) suggests five competencies for online tutors. Actions on the Penn State Learning Design Community Hub are divided into five competency areas: administrative, design, facilitation, evaluation and technical. The goals of each of the five competencies are specified. 'Administrative' competency requires that the tutor assure smooth course operations and reduce tutor and learner overload. The 'design' element assures adequate learning outcomes and satisfaction. The goal of 'facilitation' is to provide social benefits and to enhance learning. Success in 'evaluation' ensures that learners know how they will be evaluated and helps learners meet course objectives, whereas tutors with 'technical' competency make certain that students overcome barriers due to technical components.

Roni, Rikki, and Anat (2008) suggest four different types of scaffolding used by the tutor. These scaffolding types include Technical support, Content support, Procedural support, Meta-cognitive support. In providing Technical support, tutors provide technical instructions for working in an online environment such as the Internet, a forum, or a database. Tutors provide content support by adding information, elaborating and correcting information, and correcting written and verbal responses. Procedural support calls upon tutors to assist with data handling such as searching, organizing and representing data, whereas tutors provide cognitive support by presenting a course site map and highlighting the links between the site,

Table 2. Tutor's roles in online learning for facilitating the critical thinking

Domains \ Researcher	Brochet (1989)	Manson (1991)	Berge (1995)	ARIS (2001)	Goodyear et al. (2001)	Davis & Roblyer (2005)	Penn State LDCH (2008)	Roni et al. (2008)
Cognitive Domain	Discriminator /explainer	intellectual role	Pedagogical	facilitating critical thinking	content facilitator	questioning strategies	facilitation	content support /meta-cognitive support
Managerial Domain	goal setter	Organizational role	managerial	setting the scene	process facilitator	course planning/ coordinating	Administra-tive	procedural support
Social Domain	Host /pace setter /entertainer	social role	social	encouraging student collaboration		collaborative working		
Technical Domain			technical		Technolo-gist	presentation skills	technical	technical support

course topics, and specific sessions. In discussing meta-cognitive support, Roni et al. stress the rationale for tasks and learners' activities as well as the relationship between reading items, course objectives and tasks, reflection, comprehension, and the learning process. These scaffolding types are associated with critical thinking as well as meta-cognitive thinking. Their suggestions focus on the cognitive support provided by tutors.

Thus, the roles that tutors play in online learning can be classified according to four domains (see Table 2). Studies commonly divide tutors' roles into cognitive, managerial, social, and technical domains.

Research procedures

The five steps of research procedures were applied as follows: In the first step, the research problems related to critical thinking skills were identified. Then, the theories and perspectives on critical thinking skills based on literature review were summarized. The third step involved analysis of tutors' roles in support of critical thinking. In the fourth step, four experts majoring in educational technology and educational psychology validated the delineations of tutors' roles identified in the previous steps, and a study involving 62 undergraduate students was initiated to achieve further validation. The experts verified each phase and strategy as well as the tutors' roles by using a 5 point Likert scale to rate the explicability and usability of online tutors' roles in facilitating critical thinking. Next, to verify the tutors' roles, an actual online problem solving activity was implemented. In the study, 62 undergraduate students participated for 2 weeks, and 9 learners were interviewed at the conclusion. Finally, tutors' roles were determined using critical thinking. Roles were selected and determined on the basis of strengths, weaknesses, and improvements.

Results and Discussion

Using the results of this study, four phases of the problem solving process were identified: analyzing, judging, inferencing, and meta-cognitively evaluating. All of these phases facilitate critical thinking. The characteristics and activities in each phase are also identified in subsequent paragraphs.

First, during the analyzing phase of problem solving, online tutors lead learners to recognize teaching and learning processes and to set up the goal. The tutors' roles are to make learners perceive teaching and learning processes, the concept of thinking skills, and the theme. They also encourage learners to revise the goals after they devise tentative goals. In this phase, learners analyze and negotiate the scope of the problem, identify the problem, and appraise the relevant terms and effective skills.

In the judging phase, online tutors help learners establish strategies and revise previous strategies. Online tutors can also help learners perceive evaluation standards, predict learning outcomes and revise and confirm the strategies. In this phase, learners gather and assess relevant information, differentiate and classify the information, evaluate the support for valid information, question the situation, and judge the situation using effective skills.

Online tutors encourage learners to manage the processes during the inferencing phase of problem solving. In this phase, online tutors direct learners to manage goals and schedules as well as both roles played by peers and learners themselves. Learners recognize their goals based on relevant criteria, make proper deductions from the discussion results, reason the conclusions, and clarify the differences between other learners' opinions while they are managing the processes.

Finally, in the meta-cognitive evaluating phase of problem solving, online tutors focus on learners' reflections and monitoring. Tutors encourage learners to reconsider alternative opinions, propose specific steps to the solution, evaluate the logic of their thought process, and predict the outcome of thinking steps.

The three-layer cyclic diagram below shows the dynamic interactions between the domains of tutors' roles and various activities while tutors support problem solving processes and encourage critical thinking (see Figure 1).

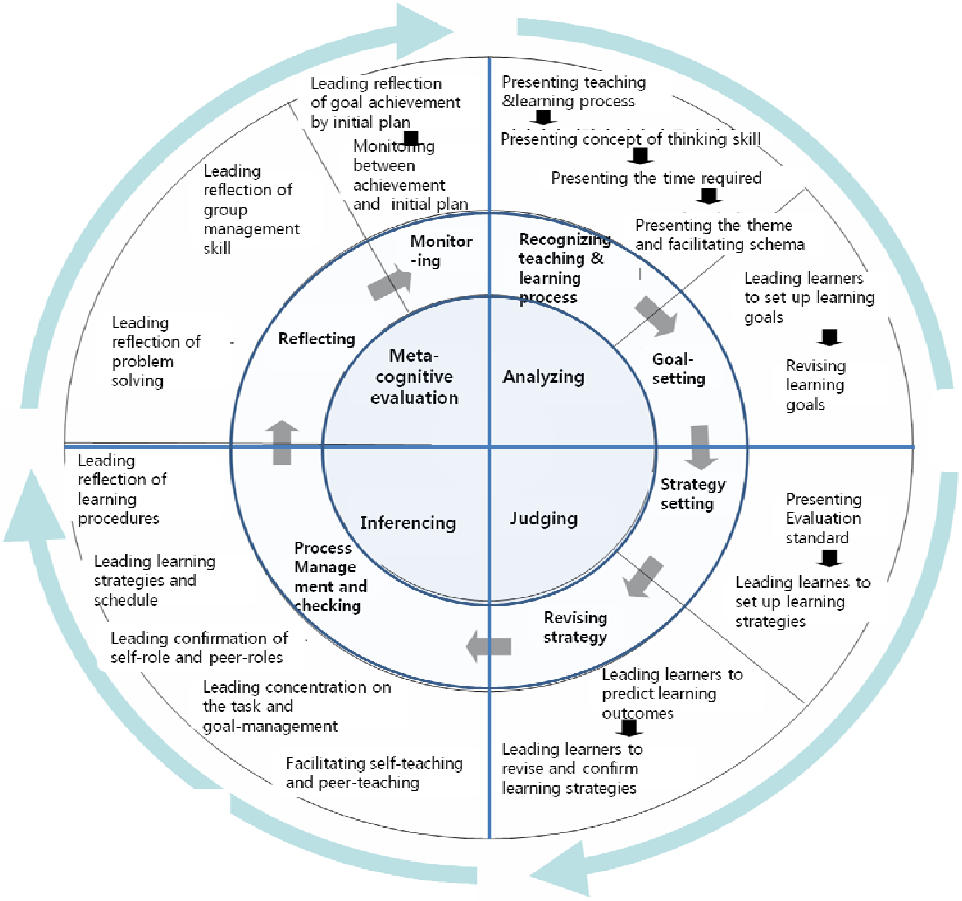

Figure 1. Tutors' roles for facilitating the critical thinking in four problem solving phases

For validating the tutor's roles, four experts verified the tutor's roles in terms of 5 point Likert scale (5=Fully verified, 1=no verified) to rate explicability, usability, validity, comprehensibility, and generality with respect to tutor's roles according to problem solving phases. The results of experts' validation were shown as 4.0 for explicability, 4.2 for usability, 4.0 for validity, 4.0 for comprehensibility, 4.2 for

generality. This result confirms that the tutor's roles for facilitating critical thinking in online problem solving is fairy valid.

After experts' validation, the implementation of online problem solving with 62 learners for two weeks and interviews with 9 learners were conducted. Their responses concerning the strengths, weaknesses, and improvements of the tutors' roles are summarized as follows.

The strengths of online tutors' roles identified by learners are summarized in Table 3. All of the learners identified systematic and reflective tutoring as the best strength. The learners confirmed that the priority of tutors' roles and the learning goal were clear when the tutors guide learners (88.9%). Moreover, learners were able to plan their learning in an efficient way (77.8%), and the discussion was logical, reflective, and dynamic (77.8%). They also indicated that directions were clear and learning contents were predictable with the tutors' help (66.7%).

Table 3. Strengths of tutors' roles from interviews with learners (N=9)

Strengths of tutors' roles from interviews with learners	Number of responses (%)
Learners were actively participated in online discussion in terms of systematic and reflective tutoring by the tutor's roles.	9 (100)
Learners evaluated that the direction was clear and the learning contents were predictable.	6 (66.7)
Learners recognized that individual learning strategy was effective according to individual feedback.	3 (33.3)
Discussion themes were clearly understandable and manageable.	4 (44.4)
Learners could efficiently manage the time.	6 (66.7)
Learners understood that the priority and the learning goal were clear.	8 (88.9)
Learners efficiently planned the problem solving strategies for enhancing critical thinking in each problem solving phase.	7 (77.8)
Reflective discussion was easily conducted in individual as well as group problem solving.	5 (55.6)
Logical and dynamic discussion was initiated by students.	7 (77.8)

Next, the weaknesses of online tutors' roles that learners identified are summarized in Table 4. The common response from all learners was 'complexity'. They felt the tutors' activities were very complicated. Several steps were redundant and unnecessary (88.9%). Sometimes they felt that tutors were interrupting with stubborn rules (88.9%).

Table 4. Weaknesses of tutors' roles from interviews with learners (N=9)

Weaknesses of tutors' roles from interviews with learners	Number of responses(%)
Learners felt tutoring processes were complex.	9 (100)
Learners felt that there were some redundant steps.	8 (88.9)
Learning was not process-oriented but product-oriented.	2 (22.2)
Discussion was too structured and not challenging.	4 (44.4)
Learners felt that tutors sometimes interrupted their problem solving processes.	8 (88.9)
Learners spent considerably more time than expected.	3 (33.3)

Table 5. Improvements in tutors' roles from interviews with learners (N=9)

Improvements in tutors' roles from interviews with learners	Number of responses (%)
The discussion needs to be procedure oriented.	9 (100)
Redundant steps need to be omitted.	6 (66.7)
Unstructured atmosphere needs to be formulated.	8 (88.9)
Whole problem solving processes need to be shared.	6 (66.7)
Tools for reflection need to be actively used.	6 (66.7)
Tutors' feedback needs to be increased.	3 (33.3)
Output oriented atmosphere needs to be changed to a process oriented atmosphere.	3 (33.3)

Finally, learners highlighted improvements in online tutors' roles that are summarized in Table 5. Based on the learners' responses about the weaknesses,

several improvement points for online tutors' roles were identified. According to the learners' responses, the discussion should be procedure oriented (100%), and the unstructured atmosphere should be formulated (88.9%). Moreover, redundant steps should be omitted (66.7%), and they want the whole problem solving process to be shared (66.7%). Some learners responded that the tools for reflection need to be actively used (66.7%).

Conclusion and Implication

The results of this research show that learners actively participate in online discussions in terms of systematic and reflective tutoring to enhance critical thinking. The existing discussion for problem solving depends only on the learners' competency. They confront difficulties at every step without systematic guidance. However, the problem solving procedures have clear steps and goals. If tutors give the facilitative strategy, learners can clearly consider the order of priority for problem solving and learning goals.

The results also show that complex procedures cause confusion. Critical thinking is a productive and efficient way of thinking. Although tutors' guidance may appear attractive, learners sometimes feel that tutors interrupt problem solving. Learners need effective activities, not brilliant ones, from their tutors. If learners feel cognitively overwhelmed, tutors' roles should be reconsidered. In subsequent research, some online tutors' roles that do not support students' problem solving will be revised or deleted. Moreover, strict tutoring can interrupt the flexibility of learners' thinking and learning processes, so tutors need to find the optimum balance between a tutor's guidance and a learner's autonomy.

The results imply that tutors should guide learners to use effective learning strategies. Learners recognize that tutors' roles need to be systematic and reflective. Tutors need to focus on the key concepts, principles and skills. Drawing on the

results of this experiment, this study has presented tutors' major roles that facilitate critical thinking and encourage students to think systematically and reflectively in online problem solving. Furthermore, the results of this research imply that tutors' roles in facilitating critical thinking are very effective in solving problems in online discussions.

To facilitate critical thinking and to support learners effectively, online tutors must recognize their own roles. Successful online discussion is vital to facilitate critical thinking skills for problem solving. In other words, successful online discussions depend upon online tutors' support. Accordingly, as mentioned above, tutors play various necessary roles that facilitate learners' critical thinking skills.

In addition, this study suggests that tutors need to consider and prepare the skills and strategies necessary to facilitate critical thinking. Supporting an effective online discussion that fosters critical thinking requires tutors to formulate appropriate questions that prompt further thinking on the subject matter. Tutors need to act as facilitators to provide students with sufficient support and strategies for critical thinking in online problem solving.

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Seong Ik PARK

Professor, Dept. of Education, College of Education, Seoul National University. Interests: Instructional Methods, Instructional Psychology, Cognitive Science, Educational Technology, Instructional Design

E-mail: seongik@snu.ac.kr

Yoon-Jung KIM

Doctoral Candidate, Dept. of Education, Graduate School, Seoul National University. Interests: Text technology, Mobile learning, Learning Science, Instructional Design in Enactivism and Embodied cognition

E-mail: bimay@hanmail.net

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