Student-generated Questioning and Quality Questions: A Literature Review

Donggil Song

Educational Technology, Department of Computer Science, Sam Houston State University. E-mail:song@shsu.edu.

ABSTRACT

Promoting students' comprehension level is a global concern in education. For example, researchers report on students' low-level of achievement in reading comprehension in different areas in the world. As an instructional technique to improve students' reading comprehension level, student-generated questioning has been investigated. Student-generated questioning requires students to identify the important information after reading a passage, and to generate questions about the points that the students think important. Though there are large amounts of empirical research on student-generated questioning, few studies were conducted on incorporating theoretical basis, up-to-date issues, or highlighting the future direction with a pedagogical viewpoint. Therefore, this study reviews empirical and theoretical evidence of student-generated questioning as an instructional technique; summarizes theoretical foundations based on the empirical evidence; identifies current issues in this research field; and makes a suggestion for future direction based on the analytic review of empirical research. An extensive literature search was conducted for the purposes. Along with the effectiveness of student-generated questioning, theoretical frameworks, and the issue of quality question, consistent guidance, and the use of technology were discussed.

Key words: Student-generated questioning, Comprehension, Scaffolding, Consistent Guidance.

INTRODUCTION

Promoting students' comprehension level is a global concern in education (Pearson and Gallagher, 1983; Smith, 2012; Trapman et al., 2016). For example, educational researchers have reported on students' low-level of achievement in reading comprehension in different areas in the world, such as primary and secondary school students in Africa (Brock-Utne, 2005; Sure and Ogechi, 2009), or language minority students in the United States (Lesaux and Kieffer, 2010) and Europe (Trapman et al., 2016). As an instructional technique to improve students' reading comprehension level, student-generated questioning has been investigated since the 1980s (Cohen, 1983; Mostow and Chen, 2009; Moseley et al., 2016). The procedure of student-generated questioning includes (1) reading a given material, (2) generating questions by students, (3) gathering and distributing the questions by the instructor, (4) solving the questions by the students, and (5) reviewing the questions by the instructor and the students. Student-generated questioning requires students to identify the important information after reading a passage, and to generate questions about the points that the students think important (van Blerkom et al., 2006). Students need to deeply think about the passage and decide (1) what it is that they need to learn in order to create a question, (2) the question's correct answer, and (3) plausible (but incorrect) distractors when creating a multiple-choice question (Authors, 2016). There has been a sizable body of conceptual and empirical research on the student-generated questioning including review papers on the effectiveness of the instructional technique (King, 1990). However, few studies were conducted on incorporating theoretical basis, up-to-date issues, or highlighting the future direction with a pedagogical viewpoint. Therefore, this study: (1) reviews empirical and

theoretical evidence of student-generated questioning as an instructional technique; (2) summarizes theoretical foundations based on the empirical evidence; (3) identifies current issues in this research field; and (4) makes a suggestion for future direction based on the analytic review of empirical research.

MATERIALS AND METHODS

An extensive literature search was conducted to identify the effectiveness and current issues of student-generated questioning which aims to support students' comprehension level. The Academic Search Complete, ERIC Databases, and Google Scholar were queried to search for literature in this field whether this was published in the area of reading comprehension, in more general education, or educational technology journals. Furthermore, several relevant papers presented at conferences were included. Dissertation abstracts were also searched via ProQuest. Titles, abstracts, and keywords were searched for student-generated questioning, student questioning, self-questioning, peer-questioning, and reciprocal questioning. The initial set of 124 references was narrowed via the following first selection criteria, the study had to: (1) deal with an intervention using student-generated questioning, (2) include empirical evidence and result analysis, (3) be published from 1970 to 2016, and (4) be published in English. Fifty-eight studies met these initial criteria, during which three additional inclusion criteria were also evaluated. The study had to: (1) measure discrete outcomes at posttests, (2) include explicit acknowledgment of the effectiveness or ineffectiveness of student-generated questioning, and (3) include sufficient information to replicate the intervention. In sum, the literature search identified 25 studies that were obtained for full review after the second screening criteria. These 25 studies were analyzed focusing on the effectiveness of student-generated questioning. In addition, the other studies that met the first selection criteria were also thoroughly reviewed to identify current issues and theoretical frameworks, and highlight future direction.

RESULTS AND DISCUSSION

The summary of the previous empirical studies on student-generated questioning is shown in Appendix 1. Interventions in the finally reviewed studies (that is, 25 studies) were mainly conducted with undergraduate or graduate students (that is, 15 studies, 60%), and four studies (16%) were conducted with middle/high school students. The rest of the studies (including the other studies that met the first selection criteria) were conducted with elementary school or younger students. For example, Gelmini-Hornsby et al. (2011) conducted an experiment with 46 children (that is, 6 or 7 years old) in the storytelling subject. Though they compared a question-prompts condition with a no-question-prompts condition, students' learning improvement was not measured in their study (thus, the study was not included in the final review). Instead, it was reported that the question-prompts group of students generated more questions than the no-question-prompts group of students. On the other hand, the finally reviewed studies report the effectiveness of student-generated questioning with empirical evidences.

Effectiveness

As shown in Appendix 1, most of the reviewed studies reported that student-generated questioning was effective in improving students' recall and comprehension scores. Other studies focused on the measurement of students' problem solving skills. Though not all studies revealed positive outcomes, most of the reviewed studies reported the effectiveness of student-generated questioning. The earliest study found in this review was published in 1975. Frase and Schwartz (1975) investigated the impact of student-generated questioning on the students' posttest recall scores. Forty-eight high school students (that is, Experiment 1) and sixty-four college students (that is, Experiment 2) were given a biographical passage. In both experiments, the authors compared a student-generated questioning group with a studying group. They reported that the questioning activity produced higher recall scores of students than the studying activity (Frase and Schwartz, 1975). The followed studies also reported the effectiveness of the questioning on students' recall and comprehension performance (King 1992a; Bugg and McDaniel, 2012). However, not all studies found positive outcomes in recall or comprehension tests. A few studies reported that student-generated questioning was not effective in improving students' recall or comprehension performance. As reviewed in King et al. (1984), earlier studies of doctoral dissertation (Bernstein, 1973; Owens, 1976; Pederson, 1976) reported that there were no differences among student-generated questioning, teacher-generated questioning, and rereading groups (that is, control groups).

In this review, two studies (King, 1991; Byun et al., 2014) extended the use of student-generated questioning from recall performance or reading comprehension into problem solving areas, but the results were different from each other. Whereas King (1991) showed the positive results of student-generated questioning on problem solving areas,

Byun et al. (2014) reported the ineffectiveness of student-generated questioning on ill-structured problem solving. Along with the performance of posttests, King (1991) investigated the impact of student-generated questioning on students' problem solving skill. Three groups were compared: a guided questioning, an unguided questioning, and a control condition. It was reported that the guided questioning group was more successful in solving novel problems than the other groups. King (1991) argues that guided questioning promotes success in problem solving. On the other hand, Byun et al. (2014) examined the effects of questioning strategies in ill-structured problem solving using the three-group setting with undergraduate students: (1) student-generated questioning (N=21), (2) revising student-generated questions using instructor-generated question prompts (N=21), and (3) question prompts provided by the instructor (N=19). The result showed that the control group (that is, question prompts provided by the instructor) performed better than other groups in overall performance in ill-structured problem solving. Byun et al. (2014) argue that students rarely try to create a high-quality question when they are not provided with any additional supports. It seems that without the effort to actively engage in the question-creating process, students are not benefit from student-generated questioning activities. This argument that describes the need for additional support is discussed in the later section in this review paper.

THEORETICAL FOUNDATION

Since most studies revealed the positive aspects of student-generated questioning, researchers in the reviewed studies suggest theoretical frameworks, which shows a broader framework than the specific aspects of student-generated questioning. Thus, this review extends the earlier reviews which focused on the cognitive process and metacognition (King, 1990; Kramarski and Dudai, 2009). Six theoretical perspectives for student-generated questioning were found in this review: (1) active text process and prior knowledge, (2) review and elaboration, (3) metacognition, (4) socio-cognitive perspective, (5) higher-order thinking, and (6) generative learning theory.

Active Text Process and Prior Knowledge

Researchers claim that student-generated questioning is an effective technique because it supports students' active text process. Students enhance their understanding and reading comprehension when they actively construct relations between their prior knowledge and the written passages (Wittrock, 1981). This type of "meaning making"

by constructing relations between the text and prior knowledge is called "active text process." When generating questions, students' attention and cognitive efforts are allocated to make meaning by finding any important information in the text and connecting the information with their prior knowledge (active text processing), which results in increased comprehension (Davey and McBride, 1986a). Student-generated questioning may initiate the students' active text process because, when generating questions, students need to think about the relations among different aspects of the text, and use their attention selectively on different text sections (Taboada and Guthrie, 2006; Meibodi et al., 2013). According to this viewpoint, student-generated questioning induces students' active text process, and in the process allows the students to focus on the important information in the text. It seems that through the student-generated questioning activity, students are engaged in analyzing the content, making relationships with prior knowledge, evaluating it, and constructing personal knowledge (King, 1989; Yu, 2009; Bates et al., 2014). Student-generated questioning also facilitates students' attention to specific textual details (King et al., 1984). Throughout this review, it was found that the effectiveness of student-generated questioning can be influenced by students' prior knowledge.

In an earlier study, Andre and Anderson (1978) investigated the effect of study technique (that is, student-generated questioning versus rereading) and prior knowledge (that is, high and low) on reading comprehension. Overall, student-generated questioning was more effective on the students' comprehension score than rereading. Specifically, the results showed that the effectiveness of student-generated questioning on the test performance of low prior knowledge students was larger than on the test performance of high prior knowledge students (Andre and Anderson, 1978). The same effect was also found in McQueen et al. (2014). The authors argued that the students with the lower level of prior knowledge were not engaged in the activity because of their low knowledge level or habitual non-engagement (McQueen et al., 2014). Thus, it seems that the students' prior knowledge plays a significant role in student-generated questioning.

In contrast, Davey and McBride (1986b) and Nolan (1991) reported that there was no significant interaction between the students' prior knowledge and the treatment effect. In addition, in their data analysis from multi-subject areas, Hardy et al. (2014) found mixed results in terms of the interaction between students' prior knowledge and the learning gains. Hardy et al. (2014) argue that the interaction effect might depend on the subject areas studies. However, the present review study could not find

any evidence for supporting this notion. Given the mixed results of the role of prior knowledge in student-generated questioning, future studies are needed on this topic. In addition, a detailed explanation about the active text process was not found in the literature in this review. Since the cognitive process includes several sub-steps from encoding information to building knowledge, more detailed investigation is required to support the active text process viewpoint.

Review and Elaboration

Another foundation for student-generated questioning is a review and elaboration theory. Creating questions may increase students' motivation for reviewing the given materials, which may result in an elaboration process. Elaboration refers to the process of "associating new material with information already known or with past experience" (King, 1992b). Student-generated questioning encourages students to review and highlight the text to create a question. This highlighting process might encourage students to elaborate the information from the reading material (van Blerkom et al., 2006). Specifically, Foos (1989) pointed out that student-generated questioning requires extra review to identify the important information after reading a passage. It seems that the extra review would lead students to the elaboration process by (1) adding details to the existing information, (2) explaining the relations between new concepts, (3) making inferences, and (4) clarifying the meaning of the text (King, 1992b; Hutchinson and Wells, 2013). Still, in this review, any attempts to measure students' review level or elaboration effort were not found. Thus, more empirical studies with robust measurements of review and elaboration are needed.

Metacognition

Along with the active text process viewpoint, metacognition is frequently addressed to explain the effectiveness of student-generated questioning. Metacognition refers to "one's knowledge concerning one's own cognitive processes or anything related to them" (Flavell, 1976), or "cognition that reflects on, monitors, or regulates first-order cognition" (Kuhn, 2000). Student-generated questioning may require students to control their questioning activity, monitor the current status, and decide what to do next. Student-generated questioning may support students to monitor their understanding as a form of self-testing, which encourages the students to get to know what they know and what they do not know (King, 1989). In addition, students need to decide what they need to learn in order to create questions (van Blerkom et al.,

2006). Since student-generated questioning is a student-centered approach, students need to be self-directed when creating questions. Therefore, it seems that students' metacognitive ability would be essential to create questions. However, it is still unclear how the activated metacognition improves students' learning performance in student-generated questioning.

Socio-cognitive Perspective

As a broader viewpoint, the socio-cognitive perspective to explain the effectiveness of student-generated questioning has been argued since the 1970s. It was proposed that student-generated questioning was related to the students' teacher-modeling behavior (Helfeldt and Lalik, 1976). Collaborative questioning facilitates peer interaction, which might lead knowledge construction by transforming old knowledge into new (King, 1990). Other studies also suggest that student-generated questioning encourages students to collaboratively build knowledge and obtain deeper understanding through the discussion with peers (Choi et al., 2005; Cho et al., 2011). With the exception of Helfeldt and Lalik (1976), most of the studies with this perspective addressed the importance of peer interaction in student-generated questioning. However, few studies deeply investigated any peer-to-peer interactions during the activity. Thus, more in-depth research on social aspects, such as types, frequencies, patterns, and lengths of interaction/conversation, group formation, or the role of individual students in a group need to be investigated further.

Higher-order Thinking

Researchers also argue that student-generated questioning is an effective strategy because it promotes higher-order thinking (Papinczak et al., 2012; Bates et al., 2014). The question-generating process might invoke inferring answers from the text (Mostow and Chen, 2009), and revising key learning outcomes and core subject material (Papinczak et al., 2012). Question creators need to generate plausible explanations for justifying their own questions, which requires the students to use their higher-order thinking abilities (King, 1992b). Nevertheless, there are some limitations in this viewpoint. For example, higher-order thinking was not defined well in the past studies. In addition, few studies attempted to measure the students' higher-order thinking in student-generated questioning. Thus, the measurement of higher-order thinking, and the effect of student-generated questioning on it should be analyzed. In addition, how the enhanced higher-order thinking supports students' comprehension level and higher performance on tests needs to be further

investigated.

Generative Learning Theory

Finally, generative learning theory (Wittrock, 1989) may explain the effectiveness of student-generated questioning by incorporating most of the perspectives described above. Student-generated questioning is considered as one of the important techniques in the theory. In generative learning theory, knowledge acquisition occurs when students generate connections between new information and prior knowledge. This is similar to the active text process perspective, but generative learning theory expands the process. According to the theory, comprehension is the result of the process of generating connections and relationships. Students integrate new information with their knowledge, and reorganize, elaborate, and/or re-conceptualize information (Lee et al., 2010). In theory, students' learning (specifically, comprehension) occurs from making connections, rather than solely by encoding information. Students are assumed to be participants in the learning processes and have the potential to regulate their own learning (Wittrock, 1981). Students selectively attend events, meaningfully generate their own knowledge, and monitor the knowledge they have generated (Wittrock, 1989).

In student-generated questioning, students need to organize the relationship among concepts, and integrate the information of reading materials with their prior knowledge. Through the generative learning processes, students' learning might be promoted in student-generated questioning. As generative learning theory incorporates some mechanisms, the theoretical frameworks of student-generated questioning that were identified in this review might have a complementary relationship between each other instead of a contradictory description. For example, the active text process perspective can also be plausible when the metacognitive process supports students' planning and monitoring. Through this process, the students' higher-order thinking might be activated and enhanced. As pointed out above, each foundation needs further empirical studies to establish a robust theory.

REMAINED ISSUE: QUALITY QUESTIONS

In this review, it was found that some researchers investigated the quantity and quality of questions as a dependent variable. Specifically, there are reports that the more questions students created, the higher performance the students showed. For example, Hardy et al. (2014) reported that the students who had created more questions scored higher in their learning performance in the final examination than the other students. Along with the quantity, the quality of questions might be related to students' learning performance. Bugg and McDaniel (2012) conducted an experiment with three groups: (1) student-generated questioning with detailed questions, (2) student-generated questioning with conceptual questions, and (3) rereading (that is, control group). Student-generated questioning groups read a given passage, and then created either detailed questions or conceptual questions whereas students in the reread group read and reread the passage. As a posttest, both detailed and conceptual questions were administered to all groups. The results of the posttest revealed that the questioning with the conceptual-question group showed higher performance than the other groups (Bugg and McDaniel, 2012). In Byun's et al. (2014) study, the trained group with question prompts performed better on the overall problem-solving tasks than the untrained questioning groups. Byun et al. (2014) claim that the training with question prompts plays a significant role in the problem solving tasks. In this type of research, the question quality measurement is a significant issue.

Measurement Criteria for the Question Quality

Researchers measured the quality of students' questions using different types of criteria. King (1989) used the criterion: how much a question applies, interprets, analyzes, or evaluates the lecture content. Specifically, factual questions are considered as low-quality questions because they require students to simply recall facts, which relates to rote learning (King, 1989). Many researchers suggested the following criteria for measuring the quality of questions: clarity (that is, lack of ambiguity) (Purchase et al., 2010; Papinczak et al., 2012; Bates et al., 2014), rationale (Choi et al., 2005), cognitive demand (Bloom's Taxonomy) (King, 1989; Papinczak et al., 2012; Bates et al., 2014), difficulty (Papinczak et al., 2012), correctness (Purchase et al., 2010; Papinczak et al., 2012; Bates et al., 2014), and plausible but false distractors (Purchase et al., 2010; Bates et al., 2014). Though those criteria were not clearly validated, there has been an effort to establish a set of criteria in a series of implementations. Guthrie and his colleagues (Taboada and Guthrie, 2004) developed a rubric for measuring student-generated questions, and Guthrie and his colleagues (Guthrie and Scafiddi, 2004; Guthrie et al., 2004, 2007) employed the rubric in their studies. The rubric uses 4 levels: (1) factual information, (2) simple description, (3) complex explanation, and (4) pattern of relationships. Using those criteria, the researchers have been able to measure the amount of high-level questions that students created. This presents the issue of how to boost the quality of the students'

questions.

Quality Questions

Along with the effort to establish the measurement process of question quality, from earlier studies, researchers have provided a training session as a preparatory activity or offered additional materials for students to create high-level questions (King and Rosenshine, 1993). King (1992b) used question stems to guide students in the student-generated questioning process, such as "What are the strengths and weaknesses of …?" and "What do you think causes …?" The guided group with question stems created more high-level questions and less recall questions than the unguided group. The question stems may prompt the higher-order cognitive processes of students by inducing extensive inference, generalization, and other elaborative activity (King, 1992b). In the study conducted by Bates et al. (2012), students participated in the weekly workshop to learn about what makes a good question, and how to create high-level questions. The workshop included group activities and practice with question templates (Bates et al., 2012). One of the reasons for providing a preparatory training is that creating high-level questions seems to improve students' learning and retention (Andre and Anderson, 1978; King, 1992b).

On the other hand, there is an argument that creating low-level questions does not hinder student learning. Hakulinen and Korhonen (2010) argue that students who created low-level questions can correct their way of thinking when they realize why their questions were low-level questions. However, this might be the case when the participants have a sufficient ability to reflect on their thinking (undergraduate or graduate students) (Foote, 1998; Bottomley and Denny, 2011). It would be difficult for younger students (elementary school students) to correct their way of thinking. In addition, there is a report that even medical students had difficulty when creating questions using Bloom's taxonomy, and they needed additional guidance (Papinczak et al., 2012). Other researchers also reported the low-rate of high-level questions during the implementations. For example, Logtenberg et al. (2011) conducted a study on student-generated questioning with 174 high school students. Students created 346 (47.5%) high-level and 358 (49.1%) low-level questions, and nine students were not able to create any questions (Logtenberg et al., 2011). Thus, it seems that extra guidance or consistent supports, rather than one-time training, for student-generated questioning might be required in some context in order for students to create quality questions.

The Need for Consistent Guidance or Scaffolding

In this review, it was found that offering a one-time training session has some limitations, such as unsustained benefits, ineffectiveness, or task characteristic dependence. In McQueen's et al. (2014) study, the students who attended the additional training session did not create more questions, and did not perform better on the course than the control group. In addition, in Choi's et al (2005) study, online training of questioning was not effective in improving the quality of questions. Thus, more dynamic and consistent guidance would be needed to support the students' creation of high-level questions. This is consistent with Yu's et al. (2013) claim that in student-generated questioning the timing and immediateness of guidance is significant. Without the consistent guidance or scaffolding that makes students control their own learning, student-generated questioning might not be as effective as expected (van Blerkom et al., 2006; Yu et al., 2013). However, few studies were conducted on the use of consistent guidance or scaffolding in student-generated questioning. Most importantly, it would be challenging to provide consistent guidance in the classroom situation. Student-generated questioning requires many steps to implement and the teacher needs to focus on facilitating the process (for example, grouping, distributing the question, reviewing the question, etc.). The teacher might not be able to provide consistent guidance to each student during the questioning activity. In order to address this issue, we can think about the use of technology for providing consistent guidance as well as facilitating the questioning process.

The Use of Technology

From the earlier studies (MacGregor, 1988; King, 1991), computerized systems were used to support student-generated questioning. After that, several online tools to allow online student-generated questioning were used in the past studies. For example, PeerWise is one of the frequently used systems for student-generated questioning. In this system, students create multiple-choice questions (that is, with the correct answer as well as the distractors) and answer the questions created by their peers (Hakulinen and Korhonen, 2010). Students comment and rate the quality of the questions, and provide some feedback for it. The question's creator and other responders can see all the comments of the question. The question creator should also provide an explanation text. The explanation is shown once the question was answered by a student (McQueen et al., 2014). In some student-generated questioning studies, a mobilized system was used to support student-generated questioning (Buckner and Kim, 2014; Authors, 2016), such as SMILE (Stanford Mobile Inquiry-based Learning

Environment).

The system is a mobile learning framework designed to promote student-generated questioning leveraging mobile media in the classroom setting. Students create a question and submit the question using mobile devices with the mobile application; a teacher distributes students' questions using the management system. Overall, researchers have used technology tools in student-generated questioning to facilitate the process (Hakulinen and Korhonen, 2010), and boost the frequency and quality of student-generated questions (Choi et al., 2005; McQueen et al., 2014). However, there has not been an effort to incorporate consistent guidance or scaffolding into technology tools in student-generated questioning studies. It would be essential for teachers to provide distributed scaffolds, which refers to ongoing and consistent supports for students through multiple approaches, methods, tools, strategies, and/or environments in order to increase the students' achievement and their learning performance (Puntambekar and Kolodner, 2005).

CONCLUSION

Most of the reviewed studies reported the effectiveness of the questioning activity. Some researchers investigated the quality of students' questions. It seems that creating high-level questions is associated with the students' learning performances. In order to encourage students to create high-level questions, the student-generated questioning procedure needs to include additional support which consistently guides and scaffolds the students to construct knowledge representations which are appropriate, accurate, and well-elaborated. Providing timely guidance in student-generated questioning in reading comprehension could be expected to increase the quality of the students' questions, promote understanding, and improve achievement by helping the students construct and elaborate on their representations of the reading text. Although the benefits of student-generated questioning are being increasingly recognized, it is also not clear from the literature which timely scaffolds are associated with the effectiveness of student-generated questioning. Little research has been conducted on how to promote students to create quality questions. Thus, it is required to investigate how consistent scaffolding affects the quality of students' questions, and their learning performance in student-generated questioning activities.

REFERENCES

Andre ME, Anderson TH (1978). The development and evaluation of a self-questioning study technique. Reading Research Quarterly. 1: 605-623.

Bates SP, Galloway RK, McBride KL (2012). Student-generated content: Using Peer Wise to enhance engagement and outcomes in introductory physics courses. Proceed. Am. Instit. Phy. Confer., pp. 123-126.

Bates SP, Galloway RK, Homer D, Riise J (2014). Assessing the quality of a student-generated question repository. Phys. Rev. ST Phys. Edu. Res. 10(2): 1-11.

Bernstein S (1973). The effects of children's question asking behaviors on problem solution and comprehension of the written word. Unpublished doctoral dissertation, Columbia University, New York.

Bottomley S, Denny P (2011). A participatory learning approach to biochemistry using student authored and evaluated multiple-choice questions. Biochem. Mol. Biol. Educ., 39(5): 352-361.

Brock-Utne B (2005). Language-in-education policies and practices in Africa with a special focus on Tanzania and South Africa: Insight from research in progress. In: Decolonisation, globalisation: Language-in-education policy and practice. A. Lin and P. Martin (Eds.). Clevedon, England: Multilingual Matters, pp. 175-195.

Buckner E, Kim P (2014). Integrating technology and pedagogy for inquiry-based learning: The Stanford Mobile Inquiry-based Learning Environment (SMILE). Prospects, 44(1): 99-118.

Bugg JM, McDaniel MA (2012). Selective benefits of question self-generation and answering for remembering expository text. J. Educ. Psychol., 104(4): 922.

Byun H, Lee J, Cerreto FA (2014). Relative effects of three questioning strategies in ill-structured, small group problem solving. Instructional Sci., 42(2): 229-250.

Cho YH, Lee J, Jonassen DH (2011). The role of tasks and epistemological beliefs in online peer questioning. Comput. Educ. 56(1): 112-126.

Choi I, Land SM, Turgeon AJ (2005). Scaffolding peer-questioning strategies to facilitate metacognition during online small group discussion. Instructional Sci., 33(5-6): 483-511.

Cohen R (1983). Self-generated questions as an aid to reading comprehension. The Reading Teacher. 36(8): 770-775.

Davey B, McBride S (1986a). Effects of question-generation training on reading comprehension. J. Educ. Psychol. 78(4): 256-262.

Davey B, McBride S (1986b). Generating self-questions after reading: A comprehension assist for elementary students. J. Edu. Res., 80(1): 43-46.

Flavell J (1976). Metacognitive aspects of problem-solving. In: The Nature of Intelligence. L. Resnick (Ed.). Hillsdale, NJ: Erlbaum Assoc, pp. 231-235.

Foos PW (1989). Effects of student-written questions on student test performance. Teach. Psychol. 16(2): 77-78.

Foote CJ (1998). Student-generated higher order questioning as a study strategy. J. Edu. Res., 92(2): 107-113.

Frase LT, Schwartz BJ (1975). Effect of question production and answering on prose recall. J. Edu. Psychol., 67(5): 628-635.

Gelmini-Hornsby G, Ainsworth S, O'Malley C (2011). Guided reciprocal questioning to support children's collaborative storytelling. Int. J.Computer-Supported Collaborative Learn., 6(4): 577-600.

Guthrie JT, Hoa ALW, Wigfield A, Tonks SM, Humenick NM, Littles E (2007). Reading motivation and reading comprehension growth in the later elementary years. Contemp. Edu. Psychol. 32(3): 282-313.

Guthrie JT, Scafiddi NT (2004). Reading comprehension for information text: Theoretical meanings, developmental patterns, and benchmarks for instruction. In: Motivating reading comprehension: Concept-Oriented Reading Instruction. J. T. Guthrie, A. Wigfield, K. C. Perencevich (Eds.). Mahwah, NJ: Erlbaum, pp. 225-248.

Guthrie JT, Wigfield A, Barbosa P, Perencevich KC, Taboada A, Davis MH, Scafiddi NT, Tonks S (2004). Increasing reading comprehension and engagement through concept-oriented reading instruction. J. Edu. Psychol., 96(3): 403-423.

Hakulinen L, Korhonen A (2010). Making the most of using PeerWise in education. In ReflekTori 2010 - Symposium of Engineering Education. Aalto University, Lifelong Learning Institute Dipoli, pp. 57-67.

Hardy J, Bates SP, Casey MM, Galloway KW, Galloway RK, Kay AE, Kirsop P, McQueen HA (2014). Student-generated content: Enhancing learning through sharing multiple-choice questions. Int. J.Sci. Edu., 1: 1-15.

Helfeldt P, Lalik R (1976). Reciprocal student-teacher questioning. The Reading Teacher. 30(3): 283-287.

Hutchinson D, Wells J (2013). An inquiry into the effectiveness of student generated MCQs as a method of assessment to improve teaching and learning. Creative Edu., 4(7): 117-125.

King A (1989). Effects of self-questioning training on college students' comprehension of lectures. Contemp. Edu. Psychol., 14(4): 366-381.

King A (1990). Enhancing peer interaction and learning in the classroom through reciprocal questioning. Am. Edu. Res. J., 27(4): 664-687.

King A (1991). Effects of training in strategic questioning on children's problem-solving performance. J. Edu. Psychol., 83(3): 307-317.

King A (1992a). Comparison of self-questioning, summarizing, and notetaking-review as strategies for learning from lectures. Am. Edu. Res. J., 29(2): 303-323.

King A (1992b). Facilitating elaborative learning through guided student-generated questioning. Edu. Psychol., 27(1): 111-126.

King A, Rosenshine B (1993). Effects of guided cooperative questioning on children's knowledge construction. J. Exp. Edu., 61(2): 127-148.

King JR, Biggs S, Lipsky S (1984). Students' self-questioning and summarizing as reading study strategies. J. Literacy Res., 16(3): 205-218.

Kramarski B, Dudai V (2009). Group-metacognitive support for online inquiry in mathematics with differential self-questioning. J. Edu. Comput. Res., 40(4): 377-404.

Kuhn D (2000). Metacognitive development. Curr. Direct. Psychol. Sci., 9(5): 178-181.

Lee HW, Lim KY, Grabowski BL (2010). Improving self-regulation, learning strategy use, and achievement with metacognitive feedback. Edu. Technol. Res. Develop., 58(6): 629-648.

Lesaux NK, Kieffer MJ (2010). Exploring sources of reading comprehension difficulties among language minority learners and their classmates in early adolescence. Am. Edu. Res. J., 47(3): 596-632.

Logtenberg A, van Boxtel C, van Hout-Wolters B (2011). Stimulating situational interest and student questioning through three types of historical introductory texts. Eur. J. Psychol. Edu., 26(2): 179-198.

MacGregor SK (1988). Use of self-questioning with a computer-mediated text system and measures of reading performance. J. Literacy Res., 20(2): 131-148.

Meibodi MK, Lakdizaji S, Abdollahzadeh F, Hassankhanih H, Rahmani A, Lasater K (2013). Impact of guided reciprocal peer questioning on the disposition of critical thinking among nursing students. Thrita J. Med. Sci., 2(3): 10-14.

McQueen HA, Shields C, Finnegan DJ, Higham J, Simmen MW (2014). Peerwise provides significant academic benefits to biological science students across diverse learning tasks, but with minimal instructor intervention. Biochem. Mol. Biol. Edu., 42(5): 371-381.

Moseley C, Bonner E, Ibey M (2016). The impact of guided student-generated Questioning on Chemistry achievement and self-efficacy of elementary preservice teachers. Eur. J. Sci. Math. Edu., 4(1): 1-16.

Mostow J, Chen W (2009). Generating instruction automatically for the reading strategy of self-questioning. Proceedings of the 14th International Conference on Artificial Intelligence in Education, pp: 465-472.

Nolan TE (1991). Self-questioning and prediction: Combining metacognitive strategies. J. Read., 35(2): 132-138.

Owens AM (1976). The effects of question generation, question answering, and reading on prose learning. Unpublished doctoral dissertation, University of Oregon, Eugene, OR.

Papinczak T, Peterson R, Babri AS, Ward K, Kippers V, Wilkinson D (2012). Using student-generated questions for student-centred assessment. Assess. Evaluat. Higher Edu., 37(4): 439-452.

Pearson PD, Gallagher MC (1983). The instruction of reading comprehension. Contemp. Edu. Psychol., 8(3): 317-344.

Pederson JEP (1976). An investigation into differences between student-constructed versus experimenter-constructed post-questions on the comprehension of expository prose. Unpublished doctoral dissertation. University of Minnesota, Minneapolis, MN.

Puntambekar S, Kolodner JL (2005). Toward implementing distributed scaffolding: Helping students learn science from design. J. Res. Sci.Teach., 42(2): 185-217.

Smith F (2012). Understanding reading: A psycholinguistic analysis of reading and learning to read. New York, NY: Routledge.

Sure K, Ogechi NO (2009). Linguistic human rights and language policy in the Kenyan education system. Cheltenham, England: Nelson Thornes.

Taboada A, Guthrie JT (2004). Growth of cognitive strategies for reading comprehension. In: Motivating reading comprehension: Concept-Oriented Reading Instruction. J. T. Guthrie, A. Wigfield, K. C. Perencevich (Eds.). Mahwah, NJ: Erlbaum, pp. 273-306.

Taboada A, Guthrie JT (2006). Contributions of student questioning and prior knowledge to construction of knowledge from reading information text. J. Literacy Res., 38(1): 1-35.

Trapman M, van Gelderen A, van Schooten E, Hulstijn J (2016). Reading comprehension level and development in native and language minority adolescent low achievers: Roles of linguistic and metacognitive knowledge and fluency. Read. Writ. Quarter.,pp. 1-19.

van Blerkom DL, van Blerkom ML, Bertsch S (2006). Study strategies and generative learning: What works?. J. Coll. Read. Learn., 37(1): 7-18.

Wittrock MC (1974). Learning as a generative process. Edu. Psychol., 19(2): 87-95.

Wittrock MC (1989). Generative processes of comprehension. Edu. Psychol., 24(4): 345-376.

Yu FY (2009). Scaffolding student-generated questions: Design and development of a customizable online learning system. Comput. Human Behavior., 25(5): 1129-1138.

Yu FY, Tsai HC, Wu HL (2013). Effects of online procedural scaffolds and the timing of scaffolding provision on elementary Taiwanese students' question-generation in a science class. Australasian J. Edu.Technol., 29(3): 416-433.

Appendix 1. Summary of the previous studies on student-generated questioning.

	Subjects	Experimental Setting	Training for questioning	Results
Reading Comprehension				
Frase and Schwartz (1975)Experiment 1	48 high school seniors and juniors	Questioning vs. Answering vs. Studying	Instructions in a printed booklet	Recall score - Questioning and Answering > Studying, $F(2,84)$ = 7.19, $p<.01$
Experiment 2	64 college freshmen	Questioning vs. Studying	Instructions in a printed booklet	Recall score - Questioning > Studying, $F(1,48)$ = 10.81, $p<.005$
Andre and Anderson (1978) Experiment 1	29 high school seniors	Questioning vs. Read-reread	Instructions in a printed booklet	Comprehension score - Interaction: treatment and verbal ability, $F(1,23)$ = 4.38, $p<.05$
Experiment 2	81 high school juniors and seniors	Questioning with training vs. Questioning with no training vs. Rereading	Instructions in a printed booklet	Comprehension score - Questioning with training, Questioning with no training > Rereading, $F(2,62)$ = 3.81, $p<.03$ - Interaction: treatment and verbal ability, $F(2,40)$ = 3.81, $p<.05$ Question quality - Training > No training, $F(1,41)$ = 6.06, $p<.025$
Helfeldt and Lalik (1976)	22 5th graders	Reciprocal questioning vs. Teacher questioning	Teacher instruction	Comprehension score - Reciprocal questioning > Teacher questioning, $t(2.086)$ = 2.301, $p<.05$
King et al. (1984).	87 undergraduates	Questioning vs. Summary vs. Control	Training with practice	Free recall score: $F(2,86)$ = 4.38, $p<.01$ - Summarizing > control Objective test score: $F(2,86)$ = 4.29, $p<.0001$ - Questioning > Control - Summarizing > Control Essay test score: $F(2,86)$ = 8.32, $p<.001$ - Summarizing > Questioning - Summarizing > Control
Davey and McBride (1986a)	125 6th graders	Question training (QT) vs. No-question training (NQT) vs. Questioning practice (GP) vs. Inference question practice (IP) vs. Literal question practice (LP)	Teacher-led training	Comprehension score, $F(4, 114)$ = 4.58, $p<.05$ - Literal items: QT>NQT; GP > IP, LP - Inferential items: QT > all others - No interaction of reading ability with treatment effect Question quality score, $F(8,226)$ = 9.19, $p<.05$ - QT > all others
Davey and McBride (1986b)	52 6th graders	Questioning vs. Read-reread	No training	Comprehension score, $F(1,48)$ = 7.30, $p<.05$ - Literal items: n/a - Inferential items: Questioning > Read-reread - No interaction of reading ability with treatment effect

Appendix 1.contd.

MacGregor (1988)	48 3rd graders	The system answered clarification questions students asked vs. The system prompted students to ask literal questions vs. The system prompted students to ask clarification and literal questions vs. Control group	No training but interaction with a computerized system	Comprehension score - Experimental groups > control, $F(1,47) = 2.94$, $p<.09$ Vocabulary score - Experimental groups > control, $F(1,47) = 9.15$, $p<.004$ - Predicted vocabulary performance : Experimental groups > control, $F(1,47) = 8.87$, $p<.004$
Nolan (1991)	42 6th, 7th graders	Questioning with prediction vs. Questioning vs. Control vocabulary intervention	Teacher-led training	Comprehension score - Questioning with prediction > Questioning, Control vocabulary intervention, $F(2,39) = 4.74$, $p<.05$ - Interaction between treatment and grade level - No interaction between treatment and reading level
Bugg and McDaniel (2012)	48 undergraduates	Questioning of detailed questions vs. Questioning of conceptual questions vs. Reread	Teacher's instruction and practice with sample questions	Cued recall score - Conceptual question, $F(2,45) = 5.33$, $p=.008$, $\eta^2 = .191$: Questioning of conceptual questions > Questioning of detailed questions, Reread Question quality, $t(30) = -8.71$, $p<.001$ - Questioning of conceptual questions > Questioning of detailed questions Judgments of learning, $F(2,45) = 3.62$, $p=.035$. - Questioning of conceptual questions > Questioning of detailed questions
Other subject areas				
Foos (1989)	94 undergraduates, Introductory psychology course	Multiple-choice questioning vs. Essay questioning vs. No questioning	No training	1st test - No difference 2nd test, $F(1,91) = 4.67$, $p<.05$ - Questioning groups > No questioning 3rd test, $F(1,91) = 3.59$, $p<.10$ - Questioning groups > No questioning
King (1989)	32 graduates/undergraduates, Elementary education course	Questioning - cooperative vs. Questioning - individualistic vs. Review - cooperative vs. Review - individualistic	Lecture with strategy practice (Question stems used)	Comprehension score - Questioning > Review, $F(3,28) = 9.85$, $p<.001$ - No difference between Questioning - cooperative and Questioning - individualistic Question quality - No changes over time

Appendix 1.contd.

King (1990) Experiment 1	26 graduates/undergraduates, Education methods course	Questioning vs. Discussion	Training with practice (Question stems used)	Lecture comprehension, $F(1,24) = 12.81$, $p<.002$ - Questioning > Discussion Verbal interaction - Questioning > Discussion

Appendix 1.contd.

Experiment 2	39 undergraduates, Education methods course	Guided questioning vs. Unguided questioning	Training with practice (Question stems used)	Lecture comprehension, $F(1,37) = 48.47$, $p<.0001$ - Guided questioning > Unguided questioning Verbal interaction - Guided questioning > Unguided questioning Problem solution, $\chi^2(2) = 7.30$, $p<.05$ - Guided questioning > Unguided questioning, Control Problem solving ability score, $F(2,19) = 4.02$, $p<.05$ - Guided questioning > Unguided questioning, Control
King (1991)	46 5th graders, Problem solving strategy	Guided questioning vs. Unguided questioning vs. Control	Question prompt in index cards, training with practice	Peer interaction - The number of explanations, $F(2,20) = 4.17$, $p<.05$: Guided questioning > Unguided questioning, Control
King (1992a)	56 undergraduates, Remedial reading and study skills course	Self-questioning vs. Summarizing vs. Note taking-review	Training, practice, and testing; Question stems provided	Lecture comprehension test, $F(2,52) = 10.84$, $p<.001$. - Self-questioning, Summarizing > Note taking-review ($ps.<.05$) Retention test, $F(2,52) = 3.43$, $p<.05$. - Self-questioning > Note taking-review ($p<.05$)
King and Rosenshine (1993)	34 fifth-graders, Science	Questioning with elaborated stems vs. Questioning with less elaborated stems vs. Unguided questioning	Training, practice (led by teachers), and prompt cards	Lesson comprehension, ANCOVA, $F(2,13) = 9.42$, $p<.01$. - Questioning with elaborated stems > Questioning with less elaborated stems, Unguided questioning ($ps.<.05$) Retention test, ANCOVA, $F(2,13) = 5.67$, $p<.05$. - Questioning with elaborated stems > Unguided questioning ($p<.05$)

Appendix 1.contd.

Foote (1998)	120 undergraduates, Unfamiliar topics (e.g., a sea bird, a religion)	Guided peer questioning vs. Guided self-questioning vs. Unguided peer questioning vs. Unguided self-questioning vs. Peer fact listing vs. Individual fact listing. This	Scripted instruction regarding the study technique	Lecture comprehension, ANOVA - Peer vs. Self: No difference - Guided vs. Unguided: No difference
van Blerkom et al. (2006)	109 undergraduates, Psychology course	Copy vs. Highlight vs. Take notes vs. Questioning	Training session	Comprehension level test, $F(3,102) = 17.14$, $p<.001$ - Questioning > Copy ($p<.001$); Highlight ($p<.05$)

Appendix 1.contd.

Bottomley and Denny (2011)	107 undergraduates, Biochemistry	n/a	Instruction (Question stems, question examples used)	Total semester mark - Positive correlation (r=0.4863, $p<.01$) between a student's PeerWise mark and the student's total semester mark.
Cho et al. (2011)	105 undergraduates, Educational technology course	Argumentation vs. Summary	Instructor-led training (Question stems, question examples used)	The number of questions - Deep-reasoning questions: Argumentation > Summary, $F(1,101) = 5.17$, p=.025, partial η^2=.05 - Argumentative questions: Argumentation > Summary, $F(1,101) = 7.55$, p=.007, partial η^2=.07 The number of student responses - Knowledge integration: Argumentation > Summary, $F(1,101) = 4.19$, p=.043, partial η^2=.04 - Agreement: Argumentation > Summary, $F(1,101) = 4.44$, p=.038, partial η^2=.04 - Critique responses: Argumentation > Summary, $F(1,101) = 10.51$, p=.002, partial η^2=.09
Hutchinson and Wells (2013)	30 undergraduates, Introduction to computer security course	n/a	Computer tutorial	Pre-posttest - Improvement, $t(29)$ = -6.641, $p<.001$
Meibodi et al. (2013)	60 undergraduates, Nursing students	Guided questioning vs. Teacher-centered lecture	The guidance of researcher (Question stems used)	Pre-posttest - Significant improvement: Guided questioning, t=3.45, p=.002

Appendix 1.contd.

Yu et al. (2013)	78 5th graders, Science class	No-scaffolds vs. Immediate-scaffolds vs. Delayed-scaffolds	Procedural scaffolding by an online learning system	Question quality, $F(2,75) = 7.23$, $p=.004$, $\eta^2 =.138$ - Immediate-scaffolds > No-scaffolds, Delayed-scaffolds
Byun et al. (2014)	205 undergraduates, Teaching method and educational technology course	Instructor question prompts (QP) vs. Peer questioning (PQ) vs. Peer questioning and revision with question prompts (PQ-R)	No training	Overall performance on ill-structured problem solving, $F(2,58) = 5.23$, $p<.01$ - QP > PQ ($d=.82$) - QP > PQ-R ($d=.81$)
Hardy et al. (2014)	5 science modules in 3 universities, Physics, Chemistry, Biology (Class size: 149 - 215)	n/a	Orientation session with scaffolding materials	Course exam (several t-test with different settings, 45 out of 100 cases: $p<.05$) - Higher-level of participants > Lower level of participants