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To See or Not to See: Effects of Online Access to Peer-Generated Questions on Performance

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ABSTRACT

This study examined the effects on performance of online access to peer-generated questions during question-generation activities. Two eighth grade classes (N = 63) participated in six weekly question-generation sessions to support English learning. An online student question-generation learning system was adopted. In contrast to expectations based on the literature on observational learning and scaffolding, no significant differences in English academic performance and weekly question-generation performance were found between the groups with and without online access to peer-generated questions. Nonetheless, the question-viewing function of the system used in this work induced a significant and immediate increase in QG performance for the group with access. Possible reasons for the unexpected non-significant results are provided with reference to limited attention theory and cognitive load theory, along with the significance of this study, as well as suggestions for instructional implementations and future research.

Keywords

Online learning space, Observational learning, Peer-assisted learning, Scaffolding, Student question-generation

Introduction

Questioning in all forms is considered to be an essential educational tool in different disciplines (Chin, Brown & Bruce, 2002). However, current classroom practice is dominated by teachers posing questions in order to assess the comprehension and cognitive abilities of their students. This generally gives primacy to instructor perspectives (Silver, 1994), and accentuates the summative rather than formative aspect of evaluation.

From the perspectives of constructivism, information-processing theory, and metacognition, student question-generation (SQG) creates situations that direct students to actively process information they see as important and relevant, and to activate, apply, organize, integrate, and construct/reconstruct personal knowledge while learning (Yu, Liu & Chan, 2005). These deep, constructive processes induce many psychological ones on the part of the learners (including rehearsal, organization, elaboration, reflection, planning, monitoring, evaluation, and revision), which lead to cognitive and metacognitive development (Andre & Anderson, 1978-79; Gillespie, 1990).

SQG has been found to promote student learning and growth in a number of studies (Brown & Walter, 2004; Luxton-Reilly, 2012; Rosenshine, Meister & Chapman, 1996), and there is thus clear empirical support for the teaching and use of SQG to enhance comprehension of learned content (Brown & Walter, 2004; Drake & Barlow, 2007; Gillespie, 1990), and to promote the growth of student cognitive and metacognitive strategies (Andre &Anderson, 1978-79), active learning (Barak & Rafaeli, 2004), diverse and flexible thinking (Andre &Anderson, 1978-79; Brown & Walter, 2004; English, 1997), problem-solving abilities (Dori & Herscovitz, 1999), intra-group communication (Yu & Liu, 2005), self-confidence (Whitin, 2004), and motivation (Chin et al., 2002). However, studies have also found that students have serious concerns over their lack of prior experience in SQG during formal schooling (Moses, Bjork & Goldenberg, 1993; Vreman-de Olde & de Jong, 2006), and thus doubts about their capabilities and performance at such tasks (Yu & Liu, 2005). Additionally, one study reported that the majority of students it examined viewed SQG as difficult or very difficult (Yu, 2009). To address these concerns, one of the current authors has been working on creating various theoretically sound designs to support SQG while building an empirical basis for their associated effects under a three-year project, starting in 2009.

Due to the wide support that peer-assisted learning has among academics and practitioners (Topping & Ehly, 1998), as well as the popularization of web 2.0 related notions such as "user as contributor," "the wisdom of crowds," "the right to remix," and "innovation in assembly" (Abramovich & Brouwer, 2008; O'Reilly, 2005), various ways to support learning and improve outcomes by the use of peer-generated work have been proposed. In view of the fact that online access to peers' work allows observation and imitation, which can provide scaffolding for learning, and that technology can play a central role in facilitating this process (i.e., the collection and instant display of student-contributed items), this study examined the effects of online access to peer-generated questions. Two theoretical perspectives which suggest that online access to peers' work may be conducive to learning are explained briefly below, before the methods used in this study are presented.

Observational learning theory

Bandura's observational learning theory, which highlights the beneficial effects on cognitive development and one's competence at a task that are derived by watching other people, is one of the most influential theories of learning and development (Lefrancois, 1999). According to Bandura, "most human behavior is learned observationally through modeling: from observing others one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action" (Bandura, 1977, p. 22). Furthermore, the process involved in observational and modeling is "one of the fundamental means by which new modes of behavior are acquired and existing patterns are modified." (Bandura, 1986, p. 118).

Allowing students to view questions their peers have generated provides opportunities for observation and modeling, and these are expected to enhance the observers' existing skills with regard to SQG, as well as their knowledge of the focal domain. However, as the issue of whether students actually benefit from viewing peer-generated questions while engaged in SQG has not yet been empirically examined in the literature, its effects on both academic and SQG performance are investigated in this study.

Scaffolding

Scaffolding, a term coined by Wood, Bruner, and Ross (1976), is a form of support that can help learners to gradually move beyond their current level of abilities (actual development) to the intended one (potential development). A number of techniques have been suggested as effective scaffolding arrangements, such as providing models or partial solutions to problems, marking critical features of artifacts or concepts, and simplifying tasks (Wu, 2010). Additionally, controlling for the elements of the task that "are initially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence" (Wood et al., 1976, p. 90) by providing scaffolding congruent with the learner's current knowledge level is seen as essential for the success of this approach (Puntambekar & Hubscher, 2005).

Supporters of scaffolding emphasize its ability to help students avoid floundering and frustration (Rummel & Kramer, 2010), reduce the extraneous cognitive load induced by random trial-and-error (Sweller, 2006), decrease student working memory load while dealing with novel information (Kirschner, Sweller & Clark, 2006), and clarify procedural or conceptual misunderstandings and incomplete knowledge (Sharma & Hannafin, 2007). Generally speaking, scaffolding positively impacts student learning and has been suggested as one of the most effective instructional interventions for producing positive learning outcomes (Swanson, 1999). Recently, the positive effects of scaffolding on student cognitive outcomes were supported by a meta-analysis carried out by Belland, Walker, Olsen and Leary (2012) that examined science, technology, engineering, and mathematics education at the K-12, college, graduate, and adult levels.

Since peers are generally within each other's zone of proximal development, peer utterances (in this case, peer-generated questions) should be more comprehensible to learners, as compared to those constructed by teachers or provided in textbooks (Ammer, 1998; Fallows & Chandramohan, 2001). Giving students access to peer-generated questions, while the task is still new to them, also allows them to see various possible forms, types, and qualities of questions. This arrangement may not only provide students with some ideas and directions for their own question-generation (QG) endeavors (thus avoiding floundering and frustration), but may also help to highlight the critical features of good questions that should be learned and imitated.

Purpose of the study and research questions

In sum, based on the concepts of observational learning and scaffolding, it is proposed that the extra space and learning opportunities provided by accessing peer-generated questions during QG may increase the learning performance associated with SQG, although the exact effects of this approach remain to be empirically substantiated. As such, this study examined the following two research questions:

- Do students with online access to peer-generated questions during SQG perform better in academic achievement as compared to those without access?
- Do students with online access to peer-generated questions during SQG have better SQG performance as compared to those without access?

While answering these questions can help in the design of better SQG activities and environments, it can also add to the broader research on constructive activities that stress the idea of 'learning by doing,' initially promoted by John Dewey (1963) (e.g., project-based learning, student-designed games, and so on). In response to contemporary approaches to teaching and learning that highlight the importance of students being engaged in meaningful and constructive learning activities, the supportive effects of online access to peer-generated work on the quality of the work produced and comprehension of the focal knowledge are important issues, and thus are considered in this study.

Methods

Experimental design and independent variables

This study adopted a quasi-experimental research method. Two groups were devised—the experimental group (with access to peer-generated questions) and the contrast group (without access) during SQG. Instructions and arrangements during the study were essentially the same for both groups (including weekly schedule, instructional content covered, supplemental materials, and in- and out-of-class assignments and activities), except that the access group had access to both the question-viewing and QG functions during QG activity, while the without access group only had access to the latter.

Students in the access group were able to observe questions produced by their peers the moment they were submitted, starting from the second QG activity. The question-viewing function was intentionally deactivated for the access group during their first activity, so that a baseline for the SQG abilities of both groups could be established. Finally, to account for both of the major processes of scaffolding – support building and support withdrawal (Puntambekar & Hubscher 2005) – the question-viewing function was deactivated for the access group during their last activity (i.e., the sixth session).

Experimental procedures

Prior to the actual study, to ensure experimental fidelity, an instructor manual delineating the implementation procedures for the respective groups was developed and closely followed. Supplemental materials containing essential information about SQG (e.g., performance assessment, operational procedures for the adopted online system) were also developed. A pilot study was conducted to ensure that the planned procedures and time allocated for each component of the SQG activities was appropriate, and that the instruction used for the experimental implementation was clear for the targeted audience (i.e., eighth graders).

Prior to the implementation of this study, a consent form containing the following information was prepared: the purpose of the study, the information to be collected from the participants and how it would be used, an assurance that confidentiality and anonymity would be maintained, and the researcher's contact information to enable correspondence, if required. To eliminate the possibility of experimenter bias brought about by differences in teaching experience, personality, communication capabilities, and so on, which would reduce the internal validity of this study (Brewer, 2000), two eighth grade classes (N = 64) taught by the same English teacher participated in the actual study, and were randomly assigned to the two treatment conditions after informed consent had been obtained.

As the principles of SQG are in alignment with current notions and strategies of computer-assisted language learning (e.g., an emphasis on learners using the target language and being cognitively engaged to create meanings in various contexts, as stressed by task-based instruction and communicative language teaching) (Brandl, 2007; Wang, 2009), it was introduced to support student learning of English as a second language, using the students' regular 45-minute weekly English study session. The SQG activities were held in the school's computer lab two weeks after the first school-wide English examination, and ended one week prior to the second exam. Two question types often used in the school-wide English examinations were chosen for the SQG activities, namely fill-in-the-blank and multiple-choice ones.

One week before the beginning of the actual study, a training session was arranged. Students were introduced to basic SQG practices, rules of thumb for generating the two chosen question types, and the operational procedures for the adopted system. Moreover, in reference to Rosenshine, Meister and Chapman (1996), effective instructional elements supporting SQG were delineated and explained to both treatment groups. These included the criteria that the teacher used to assess the performance of SQG, and models of appropriate QG (see the section on measurement for details).

Following the training session, the students were directed to generate at least four questions about recently learned English content on a weekly basis using the adopted system for a period of six consecutive weeks. Of those generated questions, at least two had to be fill-in-the-blank items and two had to be multiple-choice ones. Students were directed to generate questions about the main ideas of the study material covered each week, which were identified by the teacher prior to each QG activity. During the study, topics covered included the past progressive tense (be＋V-ing); pronunciation rules for ir, er, ur, ear, ar, er and ur; the use of when, 'not…at all,' infinitives, gerund (V-ing), 'it' as a virtual subject, 'help' followed by either a verb or noun, and prepositions followed by a gerund (for/at/about/by)＋V-ing; and a total of 90 vocabulary items. Students were encouraged to refer to textbooks, English-Chinese dictionaries, take-home worksheets, or information found on the internet during the activities.

Starting from the second week, before proceeding to the QG tasks, whole-class feedback was given, highlighting both good work and the most common mistakes found in the student-generated questions submitted the previous week from each group. For the access group, students were also briefed about the use of the question-viewing function of the adopted system, and were advised to use their time wisely when generating and viewing questions during the allocated time frame. One week after the completion of the sixth SQG activity, teacher-designed and school-wide English exams on the study content were administered.

Online learning system

An online learning system with a focus on SQG (the Question Authoring and Reasoning Knowledge System, QuARKS) was adopted to support the activity. Like all similar online systems, QuARKS enables multimedia files to be included as parts of the question; texts of different fonts, sizes, and styles can be used; and questions can be easily saved, retrieved, revised, and deleted by users (see Figure 2). However, to the best of the researchers' knowledge, QuARKS is different from other systems in at least one way– it is customizable in terms of the specific function(s) available to students at any given point in time (Yu, 2009). For the purpose of this study, both QG and question-viewing functions were activated for the experimental group, while only the QG function was activated for the contrast one (Figure 1).

For QG, students first clicked on the QG button and selected the type of question to be generated (see Figure 1), and were then directed to the appropriate space. Except for the multiple-choice questions, which demand an additional task of constructing four alternatives, students would generate a question item, provide a correct answer, and detail the main purpose or reference for each question asked (Figure 2).

With QuARKS, the teacher was able to schedule the activation or deactivation of the question-viewing function available to the access group ahead of time, or in real time. Once activated, students would click on the question-viewing function (Figure 1) to be directed to a list of peer-generated questions (see Figure 3). The list of questions could be re-sequenced by clicking on the question type, questions, version, question-poser (the exact content displayed is dependent on the identity mode chosen by this individual), submission time, and number of times viewed labels located in the first row. Students simply had to click on the 'browse' button (i.e., the eye icon,) of any specific question item to examine its full content.

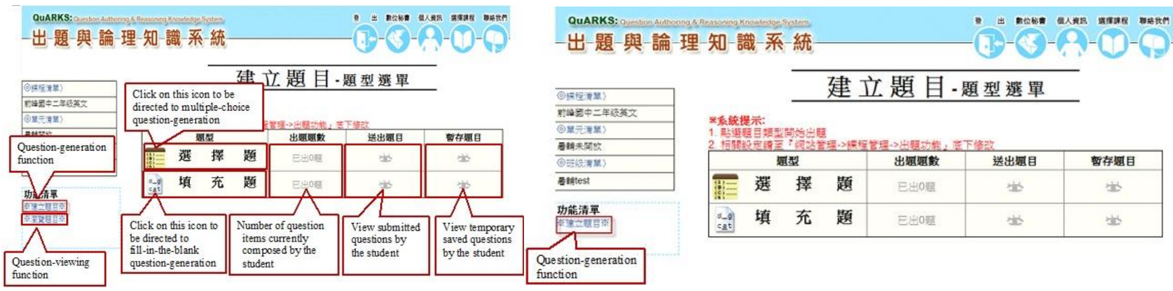

Figure 1. Learning spaces for the experimental group with both QG and question-viewing functions (left) and the contrast group with only QG function (right)

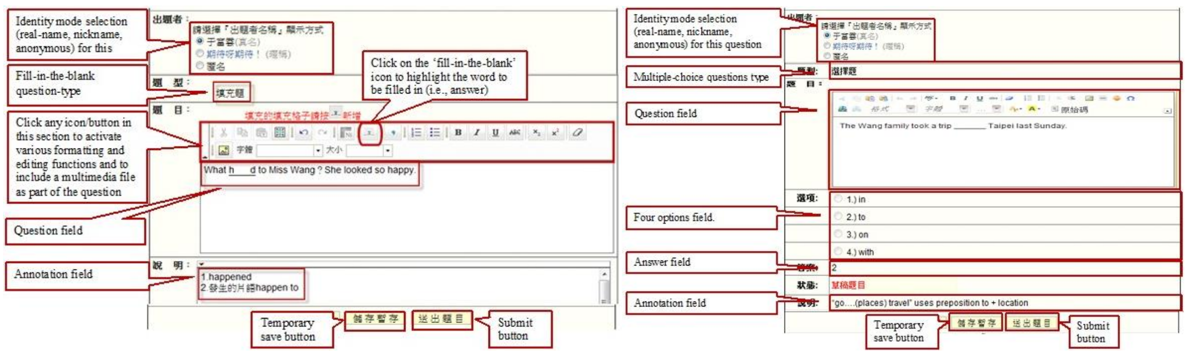

Figure 2. Spaces for fill-in-the-blank QG (left) and multiple-choice QG (right)

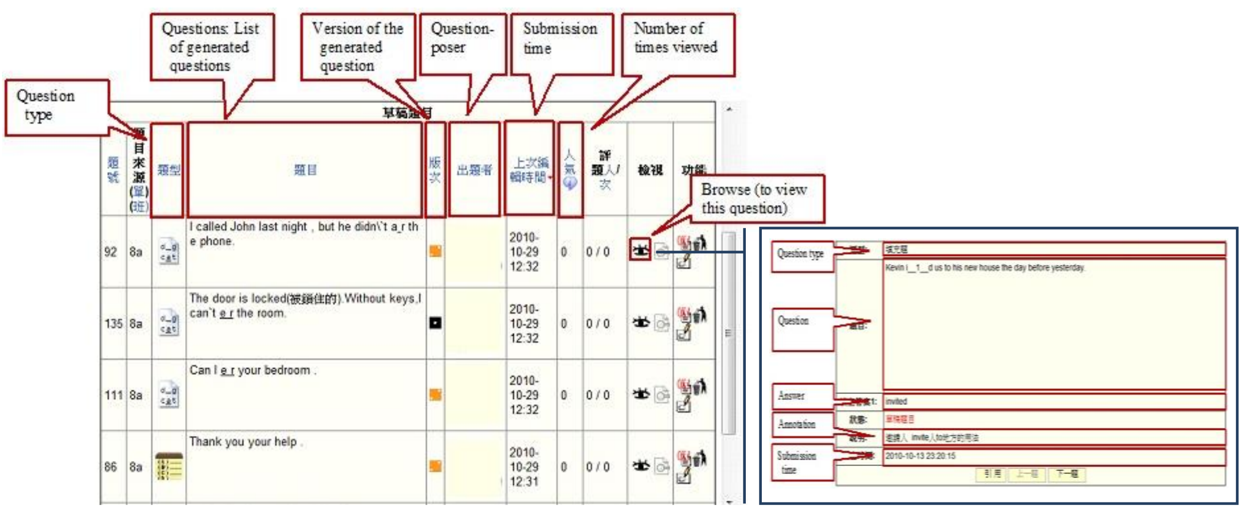

Figure 3. A screen shot of a list of peer-generated questions (left) with a pop-up screen of a peer-generated question (right)

Measurements

This study explored the relative effects of having versus not having online access to peer-generated questions during QG activities on the English academic and QG performances of two groups of eighth-grade students. Each of the instruments used to achieve this is described below.

A posttest developed by the teacher was used to assess student academic performance on the covered content. It was composed of 35 fill-in-the-blank and four-option multiple-choice question items. To ensure that items were of adequate quality, only items with a test difficulty between .35 and .85 and a discrimination index above .20 were included for data analysis. As a result, one item was excluded. The Kuder and Richardson reliability coefficient was .95, reflecting the high internal consistency of the test (i.e., students with a higher level of knowledge of the tested domain tended to answer most items correctly, while students with a lower level tended to answer most items incorrectly). The average item difficulty level was .54 (ranging from .37 to .74), indicating that the items were at an appropriate level relative to the abilities of the participants. The item discrimination index ranged from .39 to 1, which shows that the test discriminated between students with higher and lower levels of knowledge of the content being assessed. In addition, a school-wide exam was administered to all the eighth graders. In total, 44 question items on the covered content were included for item analysis and, as a result, two items were deleted. The Kuder and Richardson reliability coefficient was .96 for the 42 remaining items. The average difficulty level was .64 (ranging from .37 to .80), with a discrimination level ranging from .40 to .88.

To assess student QG performance, a set of criteria was developed with reference to the Torrance creativity index (1974) and Yu and Wu's (2013) criteria for QG performance assessment. All questions that students generated during the six QG activities were analyzed, scored, and summed up according to these criteria. Specifically, each question was graded on five dimensions: fluency, complexity, elaboration, originality, and importance. For inter-rater consistency, one English teacher (with more than six years of English teaching experience) was recruited and trained to use the criteria to assess one session of SQG performance. The Kendall coefficient of concordance between the two raters was .88. Definitions and model examples of each of the five dimensions of QG performance were explained to the students during the training session, and were available for reference throughout the QG activities (see Table 1).

Table 1. Criteria for QG performance assessment: five dimensions with associated definitions and model examples

Dimensions	Definition	Model example
Fluency	Free from spelling and grammatical errors; Precise meaning with one correct answer; Complete questions and annotations for fill-in-the blank questions, and question-stems, four options, answers, and annotations for multiple-choice questions.	Fill-in-the-blank example: Question: My father always takes a bath in the b__m after work. Answer: bathroom. Annotation: The place for taking a bath, beginning with the letter b and ending with the letter m, is bathroom. Multiple-choice example: Question: I ___ a trip to Taipei last month. (A) takes (B) did took (C) took (D) taking Answer: (C). Annotation: The verb to use with the phrase 'a trip to a place' is 'take.' As it happened in the past (last month), past tense of 'take' should be used (i.e., took).
Complexity	Involves at least two grammatical rules	Fill-in-the-blank example: Question: Let's m_p the floor on Sunday. Answer: mop Annotation: The verb, which begins with the letter m, ends with the letter p, and is associated with 'the floor', is 'mop.' [The question tests two grammatical concepts: the use of *Let's* + V and the phrase, 'mop the floor.'] Multiple-choice example: Question: Lucy ___ the bed last night. (A) makes (B) made (C) take (D) did Answer: (B) made Annotation: The verb to use with 'the bed' is 'make.' As the behavior happened last night, the past tense of 'make' should be used, which is 'made.' [The question involved two grammatical concepts: phrase 'make the bed' and the use of past tense]
Elaboration	Interconnectedness between the currently	Fill-in-the-blank example: Question: A-Mei is my favorite a___l singer.

	covered topic/unit and prior topics/units; Link to personal life experience; Plausibility of alternatives;	Answer: aboriginal Annotation: The word beginning with the letter a and ending with the letter l is 'aboriginal.' [A-Mei is one of the most famous singers in Taiwan. Her ethnic origin (i.e., aboriginal) is a fact well-known among students. This question contains knowledge of pop culture that is a part of students' everyday lives] Multiple-choice example: Question: Judy ___ very unhappy after she ___ her wallet. (A) was; lose (B) were; losed (C) is; lost (D) was; lost Answer: (D) was; lost Annotation: the verbs used should be consistent with its subject and time tense. [Past tense of the verb 'lose' is a newly learned verb; the past tense of the be+V was previously learned; all distracters are frequently made mistakes by students]
Originality	Uniqueness of a specific question as compared to those of peers.	Fill-in-the-blank example: Question: John only ate a piece of p a for dinner. Answer: pizza Annotation: the word beginning with the letter p and ending with the letter a is 'pizza.' ['A piece of' is newly learned phrase; however, 'a piece of pizza' was not specifically taught or mentioned in class, so this student was the only one to compose this specific question] Multiple-choice example: Question: Do you know what happened Mary？ (A) to (B) with (C) at (D) in Answer: (A) to Annotation: 'to' should be used with 'happen' when we want to denote something happen to someone [No students in the class composed questions using an indirect question]
Importance	Generated question focuses on essential content.	Fill-in-the-blank example: Question: What h d to Miss Wang？She looked so happy. Answer: happened Annotation: 'happen to' is the phrase to use when denoting something happening to someone. [The word 'happen' and the phrase 'happen to' are important concepts to be learned] Multiple-choice example: Question: Julia is singing and dancing. (A) good at (B) well on (C) like (D) plays Answer: (A) good at Annotation: phrase to use is 'be good at' [Be good at + sth/Ving are important grammatical concepts covered]

Data analysis

The multivariate analysis of covariance technique (MANCOVA) was used to test whether there were any differences in English academic performance (measured using the teacher-developed posttest and second school-wide exam) between the treatment groups, as a result of a statistically significant moderate correlation coefficient among the two variables (Hair, Black, Brain, Anderson, & Tatham, 2006). Scores from the first school-wide exam were used as the covariate. The QG performances of students from the two groups were compared on a weekly basis using *t*-tests.

Results

English academic performance

Table 2 summarizes the descriptive statistics for both groups' English performance. The assumption of the homogeneity of the regression was satisfied, with Wilks $\lambda = .97$, $F(1,58) = 1.04$, and $p > .05$, before proceeding to MANCOVA. The results of MANCOVA revealed no significant differences between the two treatment groups, with Wilks $\lambda = .95$, $F(1,60) = 1.65$, and $p > .05$

Table 2. Descriptive statistics for student English performance for the two groups

	1st school-wide exam[1]	Teacher-designed test[2]		2nd school-wide exam[3]	
Treatment groups (n)	Mean (SD)	Mean (SD)	Adj. Mean	Mean (SD)	Adj. Mean
Access group (30)	64.30 (30.19)	17.40 (9.79)	17.37	32.40 (9.88)	32.13
Without access group (33)	69.24 (23.90)	21.18 (9.64)	21.20	28.55 (11.25)	28.79
Total (63)	66.89 (26.97)	19.38 (9.82)		30.38 (10.71)	

[1]maximum Score: 100; [2]maximum score: 34; [3]maximum score: 42.

Student QG performance

The student' week-by-week QG performance for the six sessions is given in Table 3 and graphed in Figure 4. As shown in Figure 4, the two groups started off similarly in terms of QG performance. However, once the question-viewing function was activated for the access group in the second session, they then appeared to improve significantly. On the other hand, the slope for the without access group rose steadily from the first to the fifth week with a sudden drop in the last week.

The results of the independent-sample *t*-tests carried out between the two treatment groups did not reveal any significant differences in any of the six weeks. Nevertheless, the paired-sample *t*-tests indicated a significant difference between weeks 1 and 2, $t(29)=3.097$, $p <.05$, for the access group, but not for the group without access, $t(29) = .141$, $p > .05$.

Table 3. Descriptive statistics for weekly SQG performance and *t*-tests between groups over the six-week study period

QG	Access group (n = 30)	Without access group (n = 33)	*t*-test	*p*
1st, M (SD)	25.60 (6.49)	25.19 (6.32)	.248	.805
2nd, M (SD)	30.37 (7.50)	26.84 (11.03)	1.461	.149
3rd, M (SD)	28.70 (7.66)	28.81 (13.07)	-.043	.966
4th, M (SD)	30.93 (9.28)	30.06 (8.56)	.384	.702
5th, M (SD)	29.79 (8.16)	30.12 (10.33)	-.137	.891
6th, M (SD)	29.97 (7.88)	25.91 (9.05)	1.878	.065

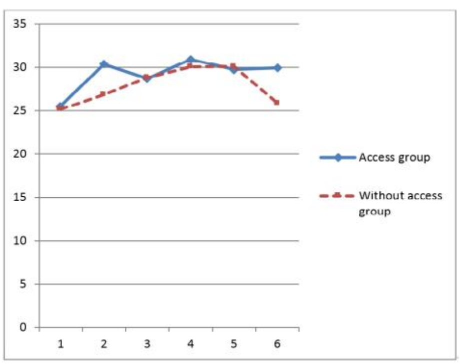

Figure 4. Week-by-week SQG performance of both groups

Discussion and conclusions

Despite the fact that studies on SQG have generally supported its positive effects on learning, a number of problems, including student concerns over the quality of the work produced, lack of experience, and perceived difficulties with regard to QG, all call for better support mechanisms or designs when this approach is being utilized. The effects that access to an online space for peer-generated questions had on student learning were thus examined in this work, based on the theories of observational learning and scaffolding.

Contrary to the authors' expectations, the results failed to reveal any significant positive effects on student performance related to having access to peer-generated questions. There may be several plausible reasons for this. First, using a controlled experimental design, the time allocated for interacting with the online system in class was fixed and limited, and kept the same for both groups in this study. However, since people have a limited capacity for attention, and only a certain amount of information can be attended to at any given time (Ruz & Lupiáñez, 2002), this implies that students in the access group operated under greater time and resource pressure, as any time and attention used to observe peers' work could not be used to generate questions. As such, any enhanced competencies gained from the observations might not necessarily have been applied to generating questions. A failure to find the positive effects on learning has also been found in other studies using learning time controls (for instance, Groβe and Renkl's (2006) study on the effects of multiple solution methods by means of worked-out examples).

Another possible reason for the non-significant results is related to the questions that could be seen by the access group. The theories of observational learning and scaffolding both call for 'exemplars' or 'models' for observation and imitation. Although studies have found that students can be capable of generating questions that reflect cognitive skills similar to those of their instructors and that cover all the major topics of interest (Luxton-Reilly 2012), the truth of the matter is that not all peer-generated questions can qualify as 'models,' and not all students possess the abilities and time management skills need to find good model questions out of all the available ones, never mind being able to learn from them. To take advantage of the capabilities of networked technologies, the questions submitted by the students in the access group were immediately made available for their peers to view. If creating 'models' is a priority, it is clear that some delays or logistical problems may surface, even with extra technological or personnel support, and offering these would likely change the observations and assessments of the related effects.

The third and final possible reason for the non-significant findings of the current work might be understood with reference to the cognitive load theory (CLT). CLT argues that learning and carrying out related activities require learners to execute cognitive efforts within the limited capacity of their working memory to process the broad range of information associated with the task at hand. Instructional strategies that exclude unnecessary information and help learners to concentrate on relevant contents could help them to effectively and efficiently manage their limited cognitive capacity (Kirschner et al., 2006; Paas, Renkl, & Sweller, 2004; Sweller, 1988, Sweller, van Merriënboer, & Paas, 1998). While peer-generated questions could serve as worked-out examples, the best known and most widely studied of the cognitive load effects, and thus decrease the external cognitive load (Pass, & van Gog, 2006; Sweller, 2006) on the part of the question-author, students are not necessarily capable of using the resultant available working memory capacity (Chi, Bassok, Lewis, Reimann, & Glaser, 1989; Gerjets, Scheiter, & Catrambone, 2004). As has already been noted, simply presenting worked-out examples does not necessarily lead to schema construction (Renkl, 1997), possibly because learners cannot differentiate relevant information from the irrelevant, and thus may fixate on less relevant features of the examples (Ross, 1989), or the learners may lack the knowledge and skills needed to learn from the provided examples (Catrambone & Holyoak, 1989). Furthermore, inappropriate ways of designing worked-out examples might increase the learners' cognitive load (Gerjets, Scheiter, & Catrambone, 2006; Pollock, Chandler, & Sweller, 2002). In particular, what cognitive load theorists describe as the redundancy effect (Sweller, 2006) may be present in this study. Specifically, the use of a full text with detailed information does not always lead to enhanced learning, as compared to the use of a summarized text, due to the fact that the extra material in the full text may be redundant (Jin, 2012). As noted above, whole-class feedback highlighting both good questions and the most commonly made mistakes was provided starting from the second QG session. The instructor's weekly feedback acted as the summarized text, while accessing the peer-generated questions resembled, to some extent, the full text. As a consequence, any beneficial effects from the online observation space that may arise for the access group might have been compensated for in the without access group by the teacher's feedback, and thus the access to the online information may have had a less significant effect than otherwise. Moreover, the unabridged, uncensored materials accessible to the access group (i.e., the peer-generated questions) may unintentionally have consumed too much of the limited cognitive capacity of the participants, and thus reduced the benefits that may otherwise have accrued from accessing peer-generated work.

Even though the two groups did not differ in terms of QG performance in any of the weeks examined in this work, it is worth noting that this performance was significantly enhanced for the access group in the first week that the question-viewing function was activated (i.e., the second week). The significantly better QG performance reflected, at some levels, what Yu, Tsai and Wu (2013) reported in their study on SQG—the immediate, positive effects of procedural scaffolding (in the form of generic question-stems with context-specific examples), although these then faded shortly afterwards.

Significance of the study and suggestions for instructors and future research

To the best of the authors' knowledge, this is the first study to empirically examine the effects of instant online access to peer-generated questions as a support mechanism for SQG. Despite being theoretically sound, this study did not confirm the superiority of having online access to peer-generated questions as compared to having no access. However, it should be noted that in the first week that the question-viewing function was activated for the access group, these learners saw a significant and immediate improvement in QG performance. In light of this, instructors dealing with students with no prior experience of QG, or other innovative constructive activities (e.g., project-based learning, student-designed gaming, and so on), might consider allowing them to have online access to peer-generated work as a form of immediate support.

Several areas for further investigation are suggested, as follows. First, in this study all QG activities were carried out in class. However, if it was designed otherwise, and thus students did not operate under a time constrained situation, and thus had more time to freely observe and construct questions, the resulting effects might have been different. That being said, the proposed effects still need to be validated empirically by a future study.

Second, almost all existing online systems that focus on QG have a peer-assessment component in place (Luxton-Reilly, 2012). With such a design, students can have access only to questions that have already passed through the peer-assessment phase, rather than to all those that have been submitted. The effects of providing online access to student-generated 'model questions' is one topic worth examining to extend the findings of the current study.

Finally, even though this study found that the question-viewing function did not lead to better academic or QG performance, as compared to the group without access to these questions, researchers and practitioners are advised to explore the effects of other types of scaffolding, such as reflective or metacognitive scaffolding (Ge & Land, 2004; Jackson, Krajcik & Soloway, 1998), with regard to the effects on SQG and learning.

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