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Development and Evaluation of Student-Generated Feedback in an Online Student-Generated Multiple-Choice Questions Learning Space

Fu-Yun YU[a] & Yu-Hsin LIU[b]
[a]*Institute of Education, National Cheng Kung University, Taiwan*
[b]*Department of Civil Engineering, National Chi Nan University, Taiwan*
fuyun.ncku@gmail.com

Abstract: An online system supporting student-generated feedback (SGF) in the context of student-generated questions (SGQ) was developed. The multi-dimensional scaffolding framework and customizable design for SGF was explained. A preliminary study was conducted to assess the perceived learning potential and difficulty of SGF with SGQ. Fifty-five middle-school aged students participated for seven consecutive weeks, and SGQ with SGF activities were integrated to support Chinese teaching and learning. Data were analyzed by descriptive statistics, chi-squared test of goodness of fit, and constant comparative method. Two major findings were obtained. First, more than 85% of the participants regarded 'SGQ with SGF' as better for promoting their learning of Chinese, by directing them to not only think further and deeper from other's perspectives, but also review course materials or look for content-related materials, altogether leading to better Chinese academic and question-generation performance. Second, more than 80% of the participants perceived SGQ with SGF as more difficult, with its intrinsic task difficulty and time constraint associated with completing the task in class. Suggestions for future research are provided, in light of the current findings and related literature on feedback.

Keywords: Online learning activity, student-generated feedback, student-generated questions, perceived learning difficulty, perceived learning potential

1. Introduction

Through decades of scientific inquiry, psychologists and educational researchers have been successful in establishing explicit design principles for instruction. Specifically, engaging students in practice activities that are directly related to learning objectives, followed up by feedback to student performance, has been suggested as one of the most powerful components that facilitates learning (Dick, Carey & Carey, 2005). Despite their highly recognized pedagogical value, the questions used in drill-and-practice (D&P) learning activities are predominantly based on test banks from textbook publishers, or constructed by teachers (Brown & Walter, 2005), with feedback mostly provided by teachers.

While the effects of a student-generated questions approach (SGQ) are well attested by researchers in a wide area of disciplines over the past decades, the potential of engaging students in generating feedback corresponding to answers to SGQ (i.e., student-generated feedback, SGF) has yet to be fully explored and understood. Since few, if any, systems supporting online SGF in response to answers given to the generated questions are available, the aim of this work is to design and develop such a system (SQG with a feedback-generation component). In addition, a preliminary study was conducted to collect data on students' perceived learning potential and difficulty regarding SGF in a SQG context.

2. Design and Development of a Scaffolded and Customizable Student-Generated Feedback Component in an Online Student-Generated Questions Learning System

To enable students to generate feedback for each of the options of a multiple-choice question, one of the authors lead her research team to design and develop a feedback-generation component within an existing online system supporting SGQ learning activities (i.e., QuARKS) (Yu, 2009). Basically, a new question format is built—student-generated multiple-choice questions (SGMCQ) with SGF. For SGMCQ, students generate a question stem, four options including the correct answer, and an annotation explaining the main ideas being tested (Figure 1a). For SGF, students provide justification for the correct answer and explanation for incorrect responses to accompany each of the options of the generated question (left of Figure 1b) to be used during online D&P sessions (Figure 2).

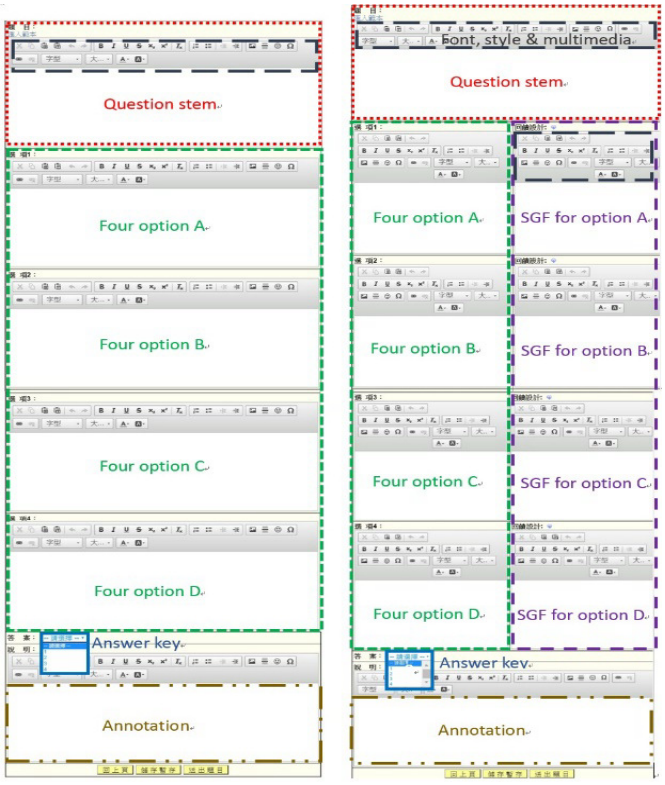

Figure 1. (a) SGQ (left); (b) SGQ with SGF (right)

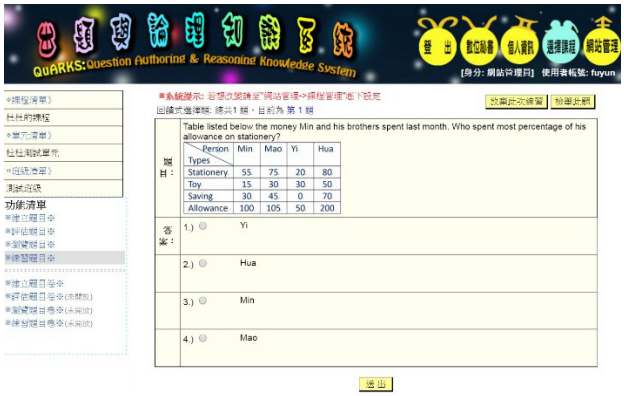

Figure 2: Sample screen-shot of system feedback to student's incorrect selection (left) to SGMCQ (right) during online D&P sessions

In addition, in light of the wide acceptance and use of emoji (i.e., emoticons) in social networking sites, and to take advantage of the multimedia capability of computer technologies, the content of the feedback is not limited to textual forms. Multi-media files, including illustrations (e.g., diagrams, charts, photographs, and graphics), animations, videos, and audio are also permissible (for example, see left of Figure 2), to allow the learner to determine the extent of media richness used.

Moreover, since students at all levels rarely have any experience of SQG (Moses, Bjork, & Goldenberg, 1993; Yu, 2009), never mind generating feedback for SQG, support mechanisms and functions for feedback-generation are designed and built. With reference to the related literature on feedback (e.g., Butler, & Winne, 1995; Chi, 1996; Dempsey, Driscoll & Swindell, 1993; King, 1994; Kulhavy & Stock, 1989; Narciss, & Huth, 2004; Schwartz & White, 2000; Shute, 2008), the support built for SGF in the system adopts a multi-dimensional framework. Briefly, as shown in Table 1, the first dimension is about the 'focus' of feedback, and concerns the substantial content of feedback. The second dimension deals with the 'forms and types' of feedback. Lastly, the third dimension relates to the 'criteria' of feedback, and deals mainly with the technical details of effective feedback.

Table 1: The 3-dimension scaffolding framework for SGF

Focus of feedback
· Task specific
· Instruction-based
· Extra-instructional
Forms and types of feedback
· Verification of response accuracy or inaccuracy
· Justification of response accuracy
· Explanation of the incorrect response: referring to the what, how, and why the exhibited performance or behavior is incorrect
· Hints, non-specific queries, or suggestions, like 'are you sure?' 'is this correct?' 'have you considered…?' to alert the responder that the chosen answer is incorrect and some areas of importance may be overlooked
Criteria of feedback
· Supportive
· Specific (referring to the current learning objectives or learning tasks)
· About the task
· Appeal (relating to peers' academic motivation, prior knowledge and skills)

Finally, as scaffolding should be carried out in relation to the intended context and target audience (i.e., context-sensitive) (Pea, 2004), the designed support function for feedback-provision adopts a customizable structure (in terms of the number of dimensions and its respective content). That is, online prompts for SGF can be revised accordingly by individual instructors to ensure that scaffolding is termed, framed, and explained appropriately for the targeted group of learners, classrooms and current instructional plans. By so doing, the situational characteristics of the instructional context, as well as individual characteristics of the learner, which Schwartz and White

(2000) and Shute (2008) suggested should be considered during feedback provision, can be included as part of the online prompts for students' consideration in SGF.

3. Preliminary Study Assessing Students' Perceived Learning Potential and Difficulties Regarding Student-Generated Feedback Learning Task besides Student-Generated Questions

Two seventh-grade classes (N=55) participated in this study for seven weeks. The learning activities (SGMCQ and SGF) were introduced to support the participants' Chinese learning by using the last of the six 45-minute instructional sessions allocated for Chinese instruction each week in the participating school's computer lab during the study.

This study consisted of three stages: training, SGQ, and SGQ with SGF. During the training stage (1st session), topics to help equip the participants with the needed knowledge and skills were emphasized. These were: the purposes and fundamentals of SGQ; criteria of multiple-choice question-generation; operational procedures for SGQ with the system; and hands-on practice on the system. For both SGQ (2nd session) and SGQ with SGF stages (3rd~7th sessions), reviews of the Chinese instruction in the current week (in the form of delineated learning objectives) and whole-class feedback on student performance with regard to the previous online learning activity was given by the instructor (10 minutes), before the students were directed to individually generate three multiple-choice questions without feedback during stage 2 (SGQ), and then questions with feedback during stage 3 (SGQ with SGF), according to the learning material covered in the current week in the system (35 minutes). During whole-class feedback, three to six pieces of student-generated work (i.e., SGQ, or SGQ with SGF), were purposively selected and shown to highlight exemplary work from the participants in their respective classes. Prior to students' first engagement in SGQ with SGF, a brief training session on SGF was arranged. During the session, the focus, types, forms, and criteria of feedback with context-specific examples from the previous lessons and the operational procedures involved in SGF within the system were first introduced, before showing how SGF works during online D&P sessions (Figure 2). Figure 3 shows the implementation procedures used in this study.

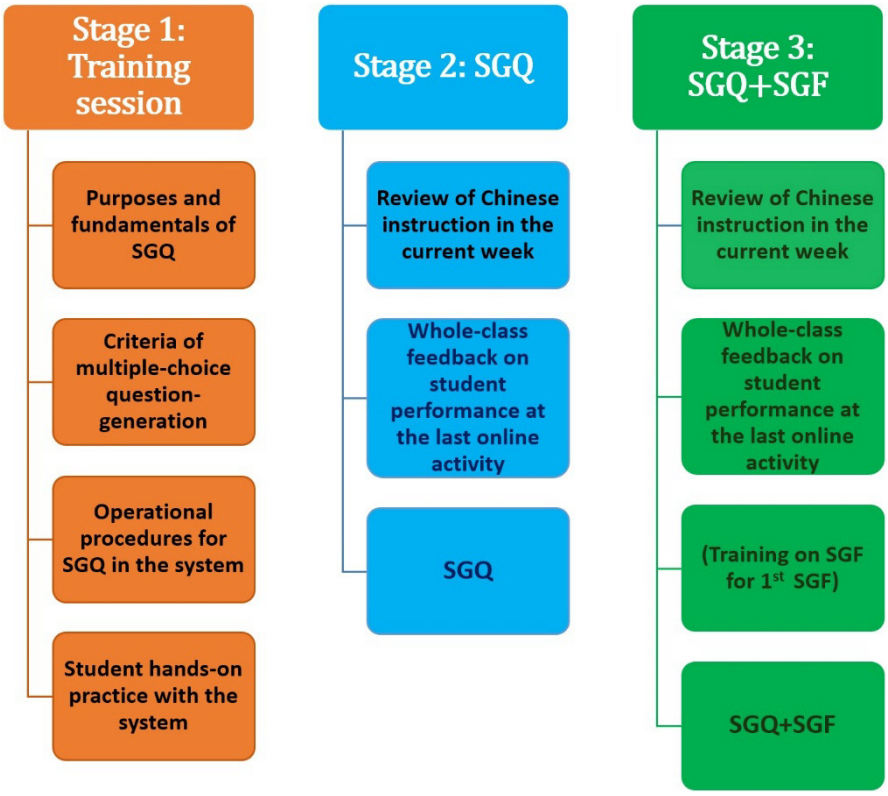

Figure 3. Implementation procedures used in this study

At the conclusion of this study, the participants were asked to individually complete a two-item questionnaire to solicit their views regarding perceived learning potential and difficulties with regard to SGQ and SGQ with SGF. Specifically, they were asked:

1. Which of the two approaches do you think better promote your learning of Chinese (SGQ, SGQ with SGF, no difference)? Please support your answer.
2. Which of the two approaches do you think are more difficult (SGQ, SGQ with SGF, no difference)? Please support your answer.

Descriptive statistics and Pearson's chi-squared test of goodness of fit were used to analyze the quantitative data, and the constant comparative data analysis method proposed by Lincoln and Guba (1985) was adopted to analyze students' descriptive responses.

Data analysis done on perceived learning potential indicated that the majority of the participants (85.45%, n = 47) regarded 'SGQ with SGF' better promoted their learning of Chinese, with 10.91% (n = 6) feeling the two approaches had similar learning potential, and only two participants voting for SGQ (n = 2). A X^2 test further indicated that the observed frequency distribution among the three arrangements was statistically significant, $X^2 = 67.67$, $p < .05$. Two salient themes emerged from the reasons the students provided to support their responses. First, more than three-quarters of the students (76.67%, n = 36) made responses that reflected the 'opportunity SGQ with SGF provided for thinking further and deeper from others' perspectives' theme (in this case, possible test-takers). As such, the constructed explanations and justifications given in response to each of the options not only helped the students to better understand the main ideas being tested in the questions, and why the answer key is the correct answer, but also raised their awareness of some possible misconceptions associated with the incorrect options. Second, the 'directing them to review course materials or look for content-related materials in other sources' theme appeared in 23.40% of the responses in favor of SGQ with SGF (n=11). As a result of engaging in the abovementioned active processes, 42.55% (n =20) of the students clearly expressed that their Chinese academic performance was promoted, and 27.66% (n =13) mentioned that their question-generation ability was enhanced.

On the other hand, data on perceived learning difficulty showed that most of the participants (83.64%, n =46) regarded 'SGQ with SGF' as more difficult, while less than 10% (9.09%, n = 5) regarded SQG as more difficult, and 7.27% (n = 4) felt there was no difference between the approaches in this regard. The results of a X^2 test showed a statistical significance of the frequency distribution observed among the three arrangements, $X^2 = 62.65$, $p < .05$. Constant comparative analysis of the students' responses further highlighted two themes—'the intrinsic task difficulty of SGF' and 'time constraint.' As many participants noted in their responses, the provision of SGF required them to look for explanations or reasons that could help test-takers to understand why each of the four options are correct or incorrect, which in itself is very demanding in terms of time and effort. In order for the SGF task to be successfully achieved, some of the participants noted that the questions should not be at low difficulty or discrimination level, and that the students should have adequate knowledge or learning materials. On another note, as the task was arranged to be completed within a 45-minute class time, it was understandable that SGF with SGQ was perceived, by most participants, as more difficult and challenging.

4. Conclusion

This study introduced an existing online learning system extended to support SGF, which included a multi-dimensional scaffolding framework and customizability to fit different classrooms and instructional plans. A preliminary study was conducted to assess its potential. The results revealed that while the majority of the participants recognized that it could enhance their learning, a number of difficulties were also noted with regard to SGF with SGQ.

The positive learning effects with regard to students' cognitive gains can be expected with reference to self-explanation theory (Chi, Bassok, Lewis, Reiman & Glaser, 1989; Chi & VanLehn, 1991; Wylie & Chi, 2014). However, the additional SGF task entails a number of cognitively demanding and time-consuming activities, and thus the learning effects of SGF with SGQ on cognitive gains as well as other learning outcomes of importance are interesting directions for future research.

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