Chen, W. et al. (Eds.) (2017). Proceedings of the 25th International Conference on Computers in Education.
New Zealand: Asia-Pacific Society for Computers in Education

Student-Generated Feedback for Online Student-Generated Multiple-Choice Questions: Effects on Question-Generation Performance and Perspective-Taking Development

Fu-Yun YU* **& Wan-Shan WU**
Institute of Education, National Cheng Kung University, Taiwan
*fuyun.ncku@gmail.com

Abstract: An experimental study examining the learning effects of student-generated feedback for online student-generated multiple-choice questions was conducted. Four seventh-grade classes (n=109) participated for eight weeks. An online learning system was extended to support the activities. The results from ANCOVA confirmed additional benefits gained from having students generate feedback for each of the options of student-generated multiple-choice questions for the promotion of question-generation performance and perspective-taking development, as compared to student-generated multiple-choice questions alone. The results were supported and explained in light of the self-explanation and empathy theories.

Keywords: Online learning activity, perspective-taking development, question-generation performance, student-generated feedback, student-generated questions

1. Introduction

The value of student-generated questions for promoting cognitive, affective and social development has been well recognized in a wide range of domains and disciplines (Rosenshine, Meister & Chapman, 1996; Yu & Su, 2015). Moreover, positive relationships between question-generation performance and academic achievement have been confirmed (Yu & Wu, 2012). In view of these findings, a growing number researchers and practitioners are expressing interest in leveraging various pedagogical arrangements for student-generated questions, in order to both increase the quality of student-generated questions and take advantage of the related learning effects.

The type of questions used in this context has been shown to affect learning. In particular, in Yu and Li's study (2011) the students who engaged in multiple-choice question-generation activities were found to have significantly better performance in higher cognitive-level achievement assessments and better use of the elaboration strategy than those engaged in short-answer question-generation activities. With this in mind, and since the current literature related to mainly involves students generating questions, this work focused on the effects of having students further generate feedback for each of the options of the generated multiple-choice questions that can be used during drill-and-practice (D&P) sessions.

Multiple-choice questions come with a specific structure that may provide added learning benefits. More explicitly, with multiple-choice question-generation the students are given opportunities to generate question stems and three to five alternative answers (consisting of the correct answer and plausible distractors) in accordance with the study material. Guidelines frequently emphasized to students during such a task include generating questions that assess the main ideas of the study material, and providing options that can detect misconceptions and differentiate those learning from those not. On the other hand, providing informative feedback following students' answers to multiple-choice questions (i.e., explanations provided for the incorrect responses and justifications given for the correct answers), factors related to instructional contexts, students (e.g., prior knowledge and skills, academic motivation) as well as the contents, presentation and functions of feedback, all need to be considered (Narciss & Huth, 2004). As such, it is anticipated that given opportunities to further generate feedback for each of the options of multiple-choice questions, students would be more likely to be prompted to

re-assess their generated question stems along with alternatives and refine the content accordingly to ensure their quality and appropriateness, with regard to their peers' knowledge and affective states in mind (e.g., level of difficulty and discrimination, wording, use of term, and so on,). In sum, the researchers speculated that through such externalization and verbalization processes prompted by student-generated feedback for student-generated multiple-choice questions, this process should have positive effects on question-generation performance and perspective-taking ability according to Chi, Bassok, Lewis, Reiman and Glaser's (1989) self-explanation and Davis's (1983) empathy theories.

2. Method

A pretest-posttest quasi-experimental research design method was adopted. Four seventh-grade classes (n=109) participated and were randomly assigned to the two treatment groups—student-generated feedback for online student-generated multiple-choice questions (the experimental group: SGQ+SGF, n=55), and online student-generated multiple-choice questions only (the contrast group: SGQ-only, n=54). The online learning activities were introduced to support Chinese learning each week in the school's computer lab for eight weeks. An existing online system (QuARKS) was extended and adopted for the activities. Basically, for SGQ, students generate a question stem, four options (including the correct answer), and an annotation explaining the main ideas being tested. For SGQ+SGF, students provide a justification for the correct answer and explanation for incorrect responses to accompany each of the options of the focal question, which are used as feedback in response to users' answer during online D&P activities. In QuARKS, multi-media files can be used as content of questions and feedback. For the design principles of the expanded system, refer to Yu and Liu (2016).

This study consisted of four main stages: training, baseline establishment and pretests, experimental intervention, and posttests. During the training stage (one session), the purposes and fundamentals of SGQ and operational procedures of QuARKS were introduced before individual hands-on practice with the system. To establish a baseline of question-generation performance and perspective-taking ability, all participants engaged in the SGQ-only condition during the 2nd stage (one session); therefore, data on the observed variables could be collected and used as covariates. Afterwards, during the experimental intervention stage (five sessions), the participants assigned to different treatment groups were engaged in SGQ+SGF and SGQ-only for the experimental and contrast groups, respectively. A brief training session on feedback-generation was provided for the SGQ+SGF group prior to their first encounter with SGF. During both the 2nd and 3rd stages, quick reviews of the Chinese instruction covered in the current week and whole-class feedback on student performance on the previous activity was given before the participants were directed to individually generate three multiple-choice questions, either with SGF (the experimental group) or without SGF (the contrast group), according to the learning material covered in the current week in QuARKS (35 minutes). At the conclusion of the 8-week study, the participants completed the same perspective-taking scale, and their question-generation performance at the last online activity was used as posttests. Question-generation performance was graded along five dimensions included by most researchers: fluency, importance, flexibility, elaboration, and originality, and inter-rater consistency was ensured (r = .82). The cognitive empathy subscale of Davis's interpersonal reactivity index (1983) was adapted to fit the situation (i.e., SQG) for perspective-taking ability assessment (6-item, Cronbach α = .89). Sample questions included: During SQG, I could view the current learning topic and SQG task from other people's perspective; During SQG, I would ask myself—if I were him/her, how would I feel or think when I review the generated question and options?

3. Results and Conclusions

The descriptive statistics of the two groups on the observed variables were listed in Table 1. The results of the analysis of covariance (ANCOVA) found significant differences in question-generation, F (1, 106) = 8.01, p = <.05, and perspective-taking performance, F (1, 106) = 5.589, p = <.05, with the students in the SGQ+SGF group having higher scores than those in the SGQ-only group.

Table 1. Descriptive statistics of the two experimental groups on the observed variables

Groups \ Variables		Question-generation Mean (standard deviation)	Perspective-taking Mean (standard deviation)
SGQ+SGF (*n*=55)	Pretest	2.95 (.74)	25.49 (5.11)
	Posttest	3.77 (.93)	26.22 (6.36)
	Adj. M	3.76	26.19
SGQ-only (*n*=54)	Pretest	2.85 (.71)	25.39 (6.01)
	Posttest	3.34 (.58)	23.52 (6.57)
	Adj. M	3.36	23.55

When given opportunities to generate feedback for the options of multiple-choice questions, in addition to providing verification of response accuracy or inaccuracy, students provide justification for the correct answer and explanations for incorrect answers. To do so, students are likely to contemplate questions such as: What kind of misconception or incomplete knowledge would the test-taker hold if he/she chose any of the inaccurate options? What kind of information can be provided to rectify such misconceptions? What and how to teach the test-taker to recognize what is presented in the question stem or alternatives that indicate the option is incorrect? On the other hand, for those choosing the correct answer, questions like the following may be considered during feedback-generation process: Can any additional pieces of information be provided to enhance or extend the test-taker's current learning status? If so, in what form? In view of self-explanation theory (Chi et al., 1989) and empathy theory (Davis, 1983), these thought processes may prompt the question-author to re-examine the questions they have already generated while keeping their peers' situations in mind if any revisions are made. As confirmed in this study, SGQ+SGF, as compared to SGQ alone, led to better question-generation performance and perspective-taking development. Overall, this study is the first work to empirically examine and yield data confirming the beneficial effects associated with SGF with SQG.

Acknowledgements

This study is supported by the Ministry of Science and Technology in Taiwan under contract number: MOST 105-2511-S-006-005-MY3.

References

Chi, M. T. H., Bassok, M., Lewis, M. W., Reiman, P., & Glaser, R. (1989). Self-explanations: How students study and use examples in learning to solve problems. *Cognitive Science, 13*, 145-182.

Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology, 44*, 113–126.

Narciss, S., & Huth, K. (2004). How to design informative tutoring feedback for multi-media learning. In H. M. Niegemann, R. BrÜnken, & D. Leutner (Eds.), *Instructional design for multimedia learning* (pp.181-195). M Ünster: Waxmann.

Rosenshine, B., Meister, C. & Chapman, S. (1996). Teaching students to generate questions: A review of the intervention studies. *Review of Educational Research, 66*, 181-22.

Yu, F. Y. & Li, M-H (2011). Effects of different types of online student question-generation on learning. *Proceedings of International Conference on Computers in Education* (pp. 768-770). November 28 to December 2, Chiang Mai, Thailand.

Yu, F. Y. & Liu, Y. H. (2016). Development and evaluation of student-generated feedback in an online student-generated multiple-choice questions learning space. *Workshop Proceedings of the 24th International Conference on Computers in Education* (pp. 413~418). IIT Bombay, Mumbai, India.

Yu, F. Y. & Su, C.-L. (2015). A student-constructed test learning system: The design, development and evaluation of its pedagogical potential. *Australasian Journal of Educational Technology, 31*(6), 685-698.

Yu, F. Y. & Wu. C. P. (2012). Student question-generation: The learning processes involved and their relationships with students' perceived value. *Journal of Research in Education Sciences, 57*(4), 135-162.