Exploring the Effects of Student Question-Generation Strategy

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Abstract: The purpose of this study is to explore the effect of student question generation strategy on students' reported use of cognitive strategies and metacognitive strategies. Furthermore, the relationship between the SQG performance and academic achievement was also examined. A single group experiment was implemented for 7 weeks. Seventy-two junior high school students from two intact history classes were recruited. Participants were engaged in the SQG task followed by the peer-assessment activity. The finding supported the positive effect of the SQG on enhancing students' use of cognitive strategies and metacognitive strategies. Additionally, students' SQG performance was significantly correlated with their academic achievement, which was supported.

Keywords: Student Question Generation, cognitive strategies, metacognitive strategies, academic achievement

1. Introduction and Literature Review

Students' ability to raise a good question relies on their use of existing knowledge to observe and interpret the newly learned content or phenomena. Therefore, it brings the needs to explore how to facilitate students in bridging the new content with their knowledge bases. The student question-generation (SQG) strategy, which is grounded on the constructivism and information processing theory, has gained more attention from the researchers and educators (i.e. Abramovich & Cho, 2006; Berry & Chew, 2008; Brown & Walter, 2005; van Blerkom, van Blerkom, & Bertscho, 2006; Yu & Wu, 2013). The question -composing and revising task could engage students in recalling, organizing or elaborating the newly learned content.

Specifically, the SQG process requires students to recall the content they just learned and identified important concepts and the concepts which their peers might be confused about. Those identified concepts could be used as the focus of the question. For example, while designing the multiple-choice question, students have to examine the interconnection among concepts and translate their understanding into the question stem in their own words or using appropriate examples. Additionally, while designing the correct answer and the three distractors, the question authors experience a micro problem-solving process (Yu, Liu, & Chan, 2005). They have to propose different solutions to the questions and examine and compare the solutions to ensure one best correct answer. Therefore, the question-generation process engages students in organizing, analyzing the learned contents, examining their understanding and misconception (Lee & Hutchison, 1998), and elaborating the contents in a meaningful way which helps to construct their schema (Bangert-Drowns, Hurley &Wilkinson, 2004; Herbert & Burt, 2004).

The SQG effects on enhancing students learning motivation, confidence, understanding of the learning materials, metacognition and so on have been supported in empirical studies. (Abramovich & Cho, 2006; Barlow & Cates, 2006; Belanich, Wisher,& Orvis, 2004; Berry & Chew, 2008; Brown & Walter, 2005; Choi, Land, & Turgeon, 2005;Dori & Herscovitz, 1999,2005; Fellenz, 2004; Ikuenobe, 2001; van Blerkom, van Blerkom, & Bertscho, 2006; Whiten, 2004; Wilson, 2004; Yu, 2005, 2009; Yu & Liu, 2005)

The purpose of this study is to further validate whether the above-mentioned SQG process would enhance students use of cognitive strategies and strategies in the context of junior high school' history course. Furthermore, as suggested, the SQG might help students' deep understanding of the learned content. The second purpose of this study is to examine whether students with better question-generation performance also performed better in the academic achievement tests.

2. Research Method

2.1 Research Design

Seventy-two junior high school students from two intact history classes taught by the same instructor were invited to participate in this study. A single group experimental design was implemented for the seven weeks. At the beginning, the purposes of the question-composing activity were explained to the participants followed by the training.

As suggested by theories and literature, the question composing task is difficult especially for those students without question composing experience (Yu, 2009), thus training on question posing is essential. Students who do not have knowledge of the quality criteria of a good question or are not familiar with the reasoning process of composing a question, might devote efforts to composing questions measuring the facts rather than higher level questions. Furthermore, without developing the schema of question-composing process, they might encounter difficulty in either translating the concepts into question stem or offering the groups of options that are highly related to the question stem. On the basis of the needs for the training, this study incorporated several components into training: the quality criteria of a good multiple-choice question stem and four options, which include one answer and three distractors, the reasoning process of question posing and revision, the explanation of the value of the SQG and hands-on practice followed by feedback.

During the intervention, the participants were required to compose two to three multiple-choice question items in accordance to each of the five instructional topics. A peer-assessment activity was conducted at the instructional session followed by the SQG activity. A whole-class feedback on SQG performance was provided and the peer's comments collected during the peer-assessment activity were sent to the question-author.

2.2 Variables and Instruments

The examined cognitive strategies were defined as students' reported use of rehearsal, elaboration and organization strategies while the metacognitive strategies were defined as their reported use of planning, monitoring and self-judgment during the learning process. These two variables were measured by the translated version of Motivated Strategies for Learning Questionnaire (MSLQ) (Garcia & Pintrich, 1995). The Cronbach's α for cognitive (10 items) and metacognitive strategies (11 items) were 0.90 and 0.89 respectively. Students rated themselves on a seven point Likert scale from "not at all true of me" to "very true of me". Scales were constructed by taking the sum of the scores of items that make up that composite construct of the scale.

Additionally, to examine SQG performance, all the questions were evaluated by two independent raters. The evaluation criteria were adopted from the index, proposed by Yu & Wu (2013) and were revised in accordance with the course instructor's suggestions. The criteria included four dimensions: Importance, fluency, elaboration and cognitive Level.

To establish the inter-rater reliabilities, one third of students composed questions were randomly selected from 822 questions and evaluated by another independent rater (N = 274). The results of the inter-rater reliability were $r = 0.87$, $p < 0.01$, which proved to be satisfactory.

To examine students' academic achievement in the five instructional units, students' performance in the school tests were collected.

3. Results and Conclusions

3.1 Findings of the SQG Effects on Students' perceptions

The descriptive statistics of the variables are listed in Table 1. It can be seen that the post-test scores of students' reported use of cognitive strategies and metacognitive strategies (Mean=4.94, 4.74, respectively) are higher than the pre-test scores (Mean=4.52, 4.33, respectively).

Table 1: Descriptive statistics (N=72)

Variable		Use of Cognitive Strategy	Use of Metacognitive Strategy
Pretest	Mean (SD)	4.52 (1.09)	4.33 (0.84)
Posttest	Mean (SD)	4.94 (1.11)	4.74 (0.99)

The paired t-test result showed that the participants' post-test score of students' reported use of cognitive strategies is significantly higher than the pretest score. (t =2.91, p = .005). Similarly, the participants' post-test score of reported use of metacognitive strategies is significantly higher than the pretest score. (t =4.12, p < .01). In other words, the participants' reported use of cognitive strategies and metacognitive strategies were significantly enhanced after being engaged in the question-generation activity.

3.2 Findings of the relationship between SQG Performance and Academic Achievement

During the seven-week intervention, 822 questions were generated by 72 participants. As specified in the data analysis section, the questions were evaluated by the two raters using the pre-defined criteria and the ratings were adopted as the indicators for students' question-generation performance.

The mean scores of students' overall achievement, achievement in each unit and question-generation performance as well as the correlations among variables were presented in Table 2. As shown, the participants' overall question-generation performance is significantly correlated with their achievement. Furthermore, in order to explore the relationship between students' question-generation performance and their gained knowledge on each unit, the correlation analyses were conducted. The results show that participants' question-generation performance in unit 1 and 2 is significantly correlated with their achievement scores gained in the test of unit1 and 2.Similiar result was found in the unit3 and 4. The hypotheses that students who generated questions of better quality tended to perform better in the achievement tests were supported in this study. In other words, the questions students posed reflected their understanding and learning of the contents.

Table 2: Correlation among Variables (N=72)

Variable	Achievement (Unit1 &2)	Achievement (Unit3 &4)	Achievement (Unit5)	Overall Achievement	Mean (SD)
QGP at w1and 2	.33** (p=.005)	.27* (p=.02)	.21 (p=.08)	.28* (p=.02)	22.89 (5.12)
QGP at w3and 4	.21 (p=.08)	.29* (p=.01)	.17 (p=.15)	.23* (p=.05)	27.58 (6.90)
QGP at w5	.12 (p=.34)	.15 (p=.22)	.13 (p=.29)	.14 (p=.26)	11.26 (2.74)
Overall QGP	.27* (p=.02)	.31* (p=.01)	.20 (p=.09)	.27* (p=.02)	52.72 (11.61)
Mean (SD)	67.50 (21.25)	71.97 (16.58)	72.39 (20.95)	70.62 (18.73)	

Note: a. QGP refers to students' question-generation performance

b. * denotes p< 0.05, ** denotes p<0.01

3.3 Conclusion

This study contributed to the literature on student question-generation. First, this study validated the effects of SQG on students reported use of cognitive strategies and metacogntive strategies. Second, this study also validated the significant correlations between students' question –generation performance and academic achievement. The instructors who are interested in SQG strategies are suggested to teach students question-generation skills by providing them with guidance, deliberated practice opportunities and in-time feedback on their question-generation performance. As this study adopted the single group experimental design, future research is suggested to take a qualitative approach to explore the difficulty students might encounter during the question –generation process. It might help to understand any potential variables that might moderate the strength of relationship between the SQG and the three examined variables. Furthermore, this study focused on exploring the potential effects of one soft technology, the instructional strategy of SQG. As a result of the limited classroom facilities and teaching time, the hard technology, such as the online question-generation system, was not allowed to integrate in the SQG process. Future research may further explore whether adoption of the online question-posing system will further enhance students' engagement in the SQG process.

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