Online Student-Constructed Test versus Online Student-Generated Questions: Students' Relative Preference, Perceived Effects for Promoting Learning, and Perceived Difficulty

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Abstract: Primary school students' relative preference, perceived effects for promoting learning, and perceived difficulty regarding online student-constructed tests (SCT) and student-generated questions (SGQ) learning activities were examined. Three fifth-grade classes (N=82) participated as part of their science learning activities for eleven weeks. An online system was adopted to support the associated learning activities. Five important findings were obtained. First, the majority of the participants did not associate SGQ or SCT with the feeling of difficult or very difficult, after being exposed to both tasks for an extended period of time. Second, a substantial proportion of students regarded SGQ and SCT as at the optimal challenging level. Third, X^2 tests indicated that participants' preferences toward SGQ and SCT were not statistically significant (X^2 =0.7), but were significant in perceived effects for promoting learning and perceived difficulty, with more participants selecting SGQ over SCT. Fourth, SGQ's facilitating effects for better promoting learning were well perceived despite that predominate percentage of the participants regarded SGQ as more difficult than SCT. Fifth, SCT's potential for knowledge integration and elaboration was rarely recognized by the participants. Implications for instruction are offered.

Keywords: online learning activities, perceived difficulty, perceived effects for promoting learning, revealed preference, student-constructed test, student-generated questions

1. Introduction

In contrast to traditional assessment approaches where learners are predominately assessed by teachers using paper-and-pencil achievement tests, in response to contemporary education paradigms, student-generated questions approach (hereafter called SGQ) has attracted the attention of an increasing number of researchers and practitioners since the past decade. Under the umbrella of multiple assessment, SGQ prides itself on providing students with opportunities to reflect back on what they view as relevant and important in the study material and generate question items around the identified areas for self- and peer-assessment. With its focus on learners and assessment for learning, and strong theoretical bases (e.g., information-processing theory, constructivism, and metacognition), empirical studies for its effects on various aspects (e.g., academic performance, attitude toward the learned subject, learning motivation, use of cognitive and metacognitive strategy) have generally been positive (Yu, 2012).

In view of its prevalent learning effects, in an attempt to further promote its fluidity, flexibility, and effectiveness, different arrangements and designs of SGQ have been proposed, for instance SGQ with online prompts in the form of key terms (Yu and Pan, 2014), SGQ under a cooperative learning situation (Yu, Wu and Hung, 2014), and SGQ with access to online database with peer-generated questions (Yu and Yang, 2014). Along this line of thought, some researchers experimented the ideas of having students construct tests around the study material (i.e., student-constructed tests, called SCT), and promising results for its support for learning and assessment have been obtained. For instance, Yu (2013) examined undergraduates' perceptions toward SCT and traditional teacher-constructed tests. Results from this preliminary study showed that

the distribution of preferences for and perceptions of these two approaches were statistically significant (X^2=48.11, X^2=22.11). Specifically, more than three-quarters of the participants selected SCT as the preferred approach for learning assessment, and more than 60% of the participants felt SCT as having better learning effects. Further constant comparative analysis of students' responses to a questionnaire regarding their experience to SGQ relative to SCT and content analysis of all items contained in the SCT all pointed to SCT's pedagogical potential for knowledge integration and elaboration (Yu and Su, 2013a, b). In another study, Yu and Wu (2015) examined the comparative effects of SCT and SGQ and empirically attested SCT' superiority for the promotion of knowledge construction in term of the breadth, depth, and interconnectivity of knowledge.

While recognizing SCT's distinct potential and effects for learning, the aforementioned studies involved undergraduate students. In view of the fact that the cognitive development and processing capability of students at different age levels are different, and that the range of tasks to be attended to during SGQ and SCT are vary (i.e., relevancy, importance, correctness of wording and punctuation, and clarity of meaning and logic of each question generated as the focus of SGQ while complete and appropriate coverage of main ideas, and appropriate item sequencing as the focus of SCT, on top of those associated with SGQ), SCT's applicability to younger age groups warrant further investigation. Hence, this study involved primary students, and their revealed preference, perceived effects for promoting learning, and perceived difficulties with regard to online SCT as compared to online SGQ were examined.

2. Methods

Three fifth-grade classes (N=82) participated in this study in the school's science lab. Two units were covered during the study: properties of an aqueous solution (e.g., PH, conductivity), and forces and motion. Three 40-minute instructional sessions were allocated for science each week. The learning activities (SGQ and SCT) were introduced to support students' science learning. Considering their predominate presence in primary school settings and students' familiarity with their forms, two question types were selected for the activity: yes/no and multiple-choice.

A four-session training session was arranged in two weeks to equip the participants with the needed knowledge and skills associated with SGQ and SCT. Topics introduced include: locating the main ideas of the study material and generating questions around the identified target in conformance with a set of criteria; generating yes/no questions in the adopted SGQ system with reference to the set criteria; generating multiple-choice questions in the adopted SGQ system with reference to the set criteria; constructing a test based on generated questions in the adopted SCT system with reference to the set criteria.

For the actual study, as a routine on a weekly basis, students were directed to individually generate five yes/no and multiple-choice question items according to the learned science material covered in the current week in the adopted online SGQ space at the last 20 minute of the instructional time. Basically, students first located areas they deemed important and relevant. Then, they generated questions around the identified areas. Finally, they keyed in their generated questions in the SGQ system using their I-pad mini, which is consisted of three fields—question (for multiple-choice questions, question is constituted of a question stem and four options), answer key, and annotation.

As a conclusion of each science unit, students were requested to construct a test, either based on questions already stored in the SGQ, or they could generate new items in the online SCT system, at the last instructional session (40 minutes). Essentially, for SCT, using their I-pad mini, students first decided the number and scoring scheme for each of the question type (i.e., test-planning stage). Students then viewed and selected any questions to be included in a test, or generated new yes/no and multiple-choice items, if feeling the need to ensure test comprehensiveness (i.e., test-compilation stage). Finally, students re-arranged the relative sequence of questions both within and between question types before submission (test-setting stage).

After participants experienced two cycles of SGQ and SCT activities, which lasted nine weeks with a total of 26 sessions, they were asked to complete a five-item questionnaire soliciting

their preferences and perspectives with regard to the exposed online SGQ and SCT learning activities. They are:

Q#1 Overall, what do you feel about the difficulty level of SGQ activity: 1 (very difficult) to 5 (very easy).

Q#2 Overall, what do you feel about the difficulty level of SCT activity: 1 (very difficult) to 5 (very easy).

Q#3 Which learning activity do you prefer: SGQ, SCT, no preference? Please explain (any particular aspects that make you like it better).

Q#4 Which learning activity do you think better help your learning: SGQ, SCT, no difference? Please explain (any differential effects it had on you, e.g., learning process, behavior, thoughts, emotions).

Q#5 Which learning activity do you think are more difficult: SGQ, SCT, no difference? Please explain (any specific areas that made the activity more difficult, challenging).

Descriptive statistics (frequencies, percentage, mean) and chi-square (X^2) tests were used for quantitative data collected from the 80 participants attended the last session of this activity. Constant comparative method was used for analyzing descriptive responses provided by the 80 participants.

3. Results

As shown in Table 1, approximately one-tenth of the participants felt that SGQ or SCT was difficult or very difficult. In fact, approximately half of all participants regarded SGQ as easy or very easy (47.50%), and more than 60% of the participants felt SCT as easy or very easy (62.50%).

Table 1: Frequencies (%) and mean of students' response regarding the difficulty of SGQ and SCT (N=80).

	1* *f* (%)	2* *f* (%)	3* *f* (%)	4* *f* (%)	5* *f* (%)	4+5 *f* (%)	Mean
Q#1 Overall, the difficulty level of SGQ	3 (3.75%)	6 (7.5%)	33 (41.25%)	20 (25%)	18 (22.50%)	71 (47.50%)	3.55
Q#2 Overall, the difficulty level of SCT	2 (2.5%)	4 (5%)	24 (30%)	29 (36.25%)	21 (26.25%)	74 (62.50%)	3.79

*1: very difficult; 2: difficult; 3: moderately difficult; 4: easy; 5: very easy

As shown in Table 2, for Q#3, approximately one-third of the participants preferred SGQ (30%), another one-third preferred SCT (37.5%), and the remaining one-third felt no preference to either approach (32.5%). A X^2 test further indicated that participants' preferences toward SGQ and SCT were not statistically significant (X^2=0.7). Constant comparative method done on students' written responses as to why they preferred SGQ revealed two major themes—its cognitive effects on promoting learning outcomes (e.g., academic performance, comprehension, creative thinking, reflecting thinking, active learning, metacognitive strategies, cognitive strategies) and its affective effects (e.g., heightened attitude toward science, learning satisfaction, test-efficacy, self-concept). Particularly, more than one-third (n=9, 37.5%) pointed out explicitly that SGQ engaged them in activities like reviewing, identifying main ideas, and monitoring their understanding of the science material, while 50% participants (n=12) appreciated SGQ's affective effects on making science learning more fun, interesting and easy. On the other hand, among those preferring SCT, more than 85% (n=26, 86.67%) pointed to its affective effects such as easy, fun and interesting, contrasting it with SGQ's more cognitive- and time-demanding nature. Finally, as for those indicating "no preference" (n=26), two distinct sub-groups emerged: liking both (n=23, 88.46%) and liking neither (n=3, 11.54%). For those liking both approaches, all acknowledged the distinct learning effects offered by different approaches. For those disliking both, the main reason was due to the many tasks involved (especially typing), which frequently resulted in uncompleted work and unpleasant feeling.

Students' responses to question #4 showed that nearly two-thirds of the participants selecting SGQ over SCT (63.29%), with only less than 5% selecting SCT over SGQ (3.8%), and a bit shy of one-third of the participants (32.91%) felt no differences (Table 2). X^2 test on perceived effects for promoting learning was statistically significant (X^2=41.95, $p < .05$). Among those selecting SGQ, most emphasized its cognitive and affective potential for learning, as described previously. When all written responses to this question were analyzed altogether, one major theme emerged—creating versus selecting/compiling. Nine students associated SGQ with creation and SCT with compilation that attributed to different perceived effects for learning.

When it comes to task difficulty (Q#5), the majority of the participants regarded SGQ as more difficult than SCT (53.75%), less than one-fifth of the participants felt the other way around (17.5%), and the rest of the participants felt no difference (28.75%) (Table 2). The X^2 test on this question was statistically significant (X^2=16.53, $p < .05$). Data analysis on descriptive comments again highlighted SGQ's cognitive, time- and effort-demanding nature for locating main ideas, monitoring personal understanding, and typing in items in the system while adhering to the set of criteria and within set time. In contrast, tasks, such as further screening and selection of item quality, sequencing in terms of item difficulty, and additional operational procedures associated with SCT were identified as what made it more difficult as compared to SGQ.

Finally, in view of the findings of past studies pointing to SCT's potential for promoting knowledge elaboration and integration, all written responses were analyzed as a whole. However, only a handful of comments noticed the additional cognitive potential prompted by SCT. Explicitly, among those (n=239), only three comments were about SCT providing opportunities for further item revision and refinement (i.e., an indication of elaboration), and six mentioned SCT for enabling students to re-examine the entire unit and to ensure that the test cover them appropriately (i.e., an indication of integration).

Table 2: Students' perspectives toward SGQ and SCT regarding their preference, perceived effects for promoting learning, and difficulty (N=80**).

	SGQ *f* (%)	SCT *f* (%)	No difference *f* (%)	X^2
Q#3 Preferred	24 (30%)	30 (37.5%)	26 (32.5%)	0.700
Q#4 Perceived as better promoting learning	50 (63.29%)	3 (3.8%)	26 (32.91%)	41.95*
Q#5 Perceived as more difficult	43 (53.75%)	14 (17.5%)	23 (28.75%)	16.53*

* $p < .05$; ** missing data: 1 for Q4

4. Discussion and Conclusions

In view of cognitive elaboration theory, effective elaboration techniques aid cognitive processing and structuring (Reigeluth, 1992, 1999). The additional tasks associated with SCT (e.g., test-planning and -setting ahead of and after the test-compilation stage to ensure that the constructed test covers and assesses all subject-matter content of importance, and that all included items are adequately arranged) should encourage greater and deeper active manipulation of the received information, leading to knowledge growth. Yet, how primary school participants, who are at a younger age, thus with limited cognitive and metacognitive capacities, reacted to this learning arrangement was examined in this study. As noted by technology adoption theorists (e.g., Davis), users' subjective attitudes would one area not to be ignored, if technology is to be accepted and actually used in the diffused setting in the long run (Davis, 1993). In particular, primary school students' preference, perceived effects for promoting learning, and perceived difficulties regarding SCT, as compared to SGQ, were investigated. Several important findings were obtained with their implications for instruction presented below.

First of all, despite the fact that studies have found that the majority of college students viewed SQG as difficult or very difficult when first encountering this activity (Yu and Wu, 2014), the

majority of participating primary school students did not associate them with the feeling of difficult or very difficult, after being exposed to SGQ and SCT learning tasks for an extended period of time (i.e., eleven weeks). In fact, a substantial proportion of students regarded them as moderately difficult, that is, an optimal challenging level with optimal motivational level, as suggested by Malone and Lepper (1987). In view of the fact that for most students the perceived difficulty level of SGQ and SCT resided within the manageable scope (i.e., not very difficult, difficult), and many regarded them as optimal challenging, both arrangements can be considered as alternative assessment and learning approaches to promote learning even for primary school students. Also, in consideration that some students regarded SGQ and SCT as very difficult or difficult, instructors interested in adopting either approaches should pay special attention to the needs of these students. Designing and provision of learning aids, such as modeling appropriate response, procedural prompts, checklists, criteria, cue card, group work (rather than individual work) (Rosenshine, Meister and Chapman, 1996), and extra-training in associated skills (e.g., typing) for SGQ and SCT may be essential for associated learning effects to manifest.

Secondly, as reflected in participants' responses, SGQ's potential for promoting comprehension, motivation, cognitive and metacognitive strategy development, active learning behavior, diverse and flexible thinking, and positive attitudes toward the subject matter studied, and so on, confirmed existing studies (e.g., Brown and Walter, 2005; Rosenshine, Meister and Chapman, 1996; Yu, 2012) to support SGQ as a promising teaching and learning approach.

Lastly, even though prior studies with undergraduates highlighted SCT's potential for knowledge integration and elaboration (Yu and Su, 2013a, b; Yu and Wu, 2015), in this study, very few participants articulated these effects. While the underlying reasons for the observed results await to be investigated, instructors interested in SCT may want to consider the provision of additional training (e.g., for grasping the overall structure of the study content via concept-mapping) and explicit instruction on the distinct aspects and performance criteria of SCT to ensure that even primary school students can make the most of engaging in SCT learning activities.

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