

AGQ: A Model of Student Question Generation Supported by One-on-One Educational Computing

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Abstract. One-on-one educational computing refers to 1 student 1 computing device, which means every student in a group uses a digital learning device. In this paper, we present a model of student question generation called AGQ, which stands for “asking a good question,” supported by one-on-one educational computing in the classroom settings. AGQ is designed for engaging students in a challenging learning activity that potentially involves higher-level cognitive processing operations. We shall describe the general design of AGQ, called Product Evolution, and that the current version is a variation of it.

Keywords: One-on-one educational computing, peer question generation, question posing

INTRODUCTION

Development of various forms of computing devices connected with wireless and wired network has advanced to a stage that these technologies have become an important part of learning environment for teachers and students (Weiser, 1998). Their advantages in supporting learning includes increasing availability and accessibility of information, engaging students in learning-related activities in diverse physical locations, supporting group work on projects, and enhancing communication and collaborative learning in the classrooms (Gay et al., 2001, Goldman et al., 2001).

One-on-one educational computing classroom (1:1 classroom) refers to a classroom in which every student uses a digital learning device, such as personal digital assistant, notebook, tablet PC, etc., to participate in learning activities. WiTEC or its subsequent DCE (digital classroom environment) system (Huang, et. al., 2001; Liu, et. al., 2003, 2002, 2003) are examples of 1:1 classroom that can potentially reduce time for the teacher to do tedious logistic work such as dispatching and collecting worksheets, grading quiz, recording teaching and learning processes as portfolios, engaging students in learning activities, enabling teacher to monitor student learning states, and facilitating group collaborative learning.

In this paper, we describe a CSCL model for supporting learning by asking questions in 1:1 classrooms called AGQ. We explain the rationales of its general design, called Product Evolution, which intends to make AGQ engaging, like a social game, while at the same time be able to elicit student cognitive operations. After delineating the technology support for AGQ, we discuss observations of a pilot study in a graduate course and future improvement.

AGQ: ASKING GOOD QUESTIONS

“Did you ask a good question today?” Isidore Rabi’s mother always asked, instead of asking “Did you learn anything in school today?” by others’ mothers. Rabi, a Nobel laureate in physics, credited this difference, asking good questions, as the reason why he became a scientist (Ciardiello, 1998). Einstein also mentioned “The mere formulation of a problem is far more essential than its solution, which may be merely a matter of mathematical or experimental skills. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances in science.” For emphasizing the importance of

questioning, he also said, “Learn from yesterday, live for today, hope for tomorrow. The important thing is not to stop questioning.” (http://www.brainyquote.com/quotes/authors/a/albert_einstein.html)

PRODUCT EVOLUTION METHOD AND DCC PROCESS

The essential learning is to engage students in the meaningful activities. Questioning is a valuable learning tool, not only for the answerer, but also for the questioner. It is important for students to create their own explanations of the information around them (Geelan, 1997). The activity of designing question and answer (Q&A) helps students retain and relate new information to prior knowledge. It gives students a chance to start to formulate answers by retrieving information from long-term memory. When students engage in the task of constructing and self-assessing Q&As they composed, students need to construct a question and build the answer corresponding to the question, indicate which part of the learning material is important and worth to test and clarify his comprehension of the learning material. In sum, questioning is a strategy to guide students to develop a repertoire of cognitive abilities (Balajthy, 1984; Ciardiello, 1998; Yu et al., 2002) – recall prior knowledge, search or inspect the learning material, identify the main ideas and concepts, make connections between them, and so forth. In this paper, we discuss the questioning in the situation which students design to test their peers.

Questioning can be of various modes (Gadamer, 1990). AGQ, which stands for “asking a good question,” is the current version of a series of our effort in designing penetrating questions and evaluation of answers (Yu, 2004). AGQ adopts a cognitive conflict resolution process, called DCC process, consisting of three sub-processes, differentiated products, cognitive conflict, and common product. “Differentiated products” is a deliberate strategy for creating individual differences by summoning individuals to generate ideas, questions, articles, and so forth, which we term as products. In the case, AGQ encourages students to produce Q&As. This requires prior knowledge and creative thinking of individuals and because of uniqueness of individual past experiences, the products generated must be different in some aspects. “Cognitive conflict” is to put individuals together and demand them to develop some common consensus on their generated products. Because of the differences in their products, they have to explain, analyze, evaluate and discriminate their products. This sub-process commands critical thinking. Finally, “common product” calls for ability of modification and synthesis of their differentiated products into a common product.

Applying DCC, individuals generate their differentiated products. And then, small teams of a class are formed from individuals and finally generate their common products. If we apply DCC again, then larger teams are formed merging smaller teams in the previous round and the common product could in general be better than the previous one. We can repeat DCC process until the final round in which either there is only one team left, that is, the whole class, or the teams in the final round are competing teams and these teams participate in a contest for evaluating their final products. We call such a method of successively applying DCC as product evolution method (PEM).

Of course, there are various versions of PEM. According to the learning material, the teacher may assign types of questions based on the six categories of cognitive domain (Bloom, 1956). Also, PEM can be applied to other small group learning other than generating questions. For example, in the Reciprocal Teaching method (Palinsar & Brown, 1984) for text reading comprehension, a small group of students take turn for questioning, clarification, summarization, and prediction. Now, suppose we require a small group of 4 students, instead of having them all generate questions, every member has to conduct a different prescribed task, such as those described in Reciprocal Teaching. Then the product evolution method will become a variant of Jigsaw method.

CURRENT AGQ PROCEDURE

Since there are not many students in the graduate course for the pilot test, the current version of AGQ is a simple form of PEM and DCC is applied only once. There are five phases: (1) Teacher-led presentation of learning material; (2) Self-study of learning material and individual Q&A generation; (3) Q&A assessment; (4) Small group formation and conflict resolution; and (5) Teacher-led class-wide discussion. Noticed that the (2), (3), and (4) is a DCC process. To carry out AGQ, one or two class periods are needed.

We choose multiple choice questions as the form of our questioning since multiple choice question items are the most familiar type of questions for students. A multiple choice item includes a question stem, an exactly correct option and three alternatives. To construct a multiple choice question, a student has to design a question stem with clear and definite description, make an exactly correct option corresponding to the question stem and three alternatives with well-attractive description. In other words, they have to understand the concept involved in the question and the relations between the correct option and the other alternatives. And the orders of four opinions are needed to be well-arranged. Figure 1 below delineates the interface for a student to design a multiple choice question item.

After every student generates her Q&A, there is a reflection process. First, a student self-assesses her Q&A with a set of rubrics. Following that every Q&A is sent to two anonymous peer reviewers for peer-assessment.

This also means that every student anonymously reviews two Q&As from two other students'. Anonymous reviews are judged more critically than those made in the identifiable condition (Zhao, 1998). After that, all the mutual reviewers are told to form triads and now every student knows who two other students review her Q&A previously. The objective of each triad is to send two items for the class-wide discussion led by the teacher. They have to determine which two items to be sent from the three they have. In order to resolve the conflicts, each student in the triad has to elaborate, justify, or clarify possible confusions on the ideas of her own item, and correct the item according to her teammates' comments. They try to reach their best consensuses in this negotiation process—not just finish the task. Some revisions might be needed before sending them out. (Figure 2) illustrates the interface of the self and peer assessment form.

座號: 21

題幹: What is not the issue of WEST

正確答案 選項

- ☐ 1: mathematical skills
- ☒ 2: skills to ask a good question
- ☐ 3: skills needed to play WEST
- ☐ 4: general skills of game-playing

Figure 1. Work space of individual question design

In the phase of teacher-led class-wide discussion, every student has to answer and give scores to all Q&As from every triad. Teacher also scores for all the products with explanation, but possibly with weight different from a student. Viewing products from other teams broadens the horizon of their thought. Teacher points out if there are misconceptions and misunderstandings. Finally, the system sums up the scores given by students and the teacher. The teacher's role in this class-wide discussion is necessary for pointing out some common misunderstandings with clarifications and explanations in time for the whole class, avoiding the same misunderstandings to happen in the future.

項目	自評	互評	互評
這個問題有在本次活動的主題範圍內 (Y/N)	Y	Y	10
這個問題的點意清楚明確 (Y/N)	Y	Y	
這個問題的答案設計的很好, 有助於釐清迷思概念 (1-5)	4	4	
這個問題設計的有創意 (1-5)	3	3	
這個問題有公認的正確答案, 沒有爭論的答案存在 (1-5)	4	5	

Figure 2. Self-assessment and peer-assessment forms

Follow from that, every student has to answer all questions composed by other groups individually and then compares his/her answers with the answers given by others and then rank all the Q&As. The teacher also ranks all the Q&As with explanation. Based on the rankings by students and that by the teacher, possibly with different weights, the ranking of the teams can be decided.

ONE-ON-ONE CLASSROOM SUPPORT FOR AGQ

The information could be effectively transferred from the handheld network to social network in a mobile computer supported collaborative learning activity (Zurita et al., 2004). Advancement of technology enables CSCL to extend the traditional collaborative learning activities to include computing capabilities, offering new possibilities for achieving more effective and attractive learning activities. The emerging of mobile technology even provides the potential that every learner has her owned personal devices for participating learning activities all the time and at different locations. In such a mobile learning environment, it is easier for learners to exchange information and more social interactions allowed (Jansen et al. 2003; Zurita et al., 2003).

Integration of digital devices with wireless and wired network connection provides an environment for computer-mediated face-to-face interactions. This environment empowers the conflict resolution process when every member can look at what she has done from individual view or what they have done from the integrated view on demand with annotation facilities. The movements among students in the classroom are at ease with the support of wireless communication. It is also a simple task for the teacher to assign students into small groups and every member of a small group can generate their questions and answers in the AGQ procedure.

Without the support of the digital devices and related technologies, there are some tedious works to run AGQ using flash cards or papers. For example, a student needs a piece of paper to construct her question and answer (Q&A). After copying the Q&A with several pieces of papers for self-assessment and peer-assessment of the items, some more papers will be used in the small group collaboration. Dispatching papers is also a time consuming process. One-on-one classroom can address these problems and much easier for some logistic task. For example, in the anonymous peer-assessment process, system can distribute Q&As directly to anonymous reviewers in a second.

TRIAL TEST

A trial test of AGQ was conducted in a graduate course. There were twenty-one graduate students with Table PCs to participate in the experiment. Before starting the procedure of AGQ, a collaborative presentation of learning material was carried out by some students. And then, each student composed a multiple choice about the learning material as their learning task in the first phase. After the composing phase, each student had to anonymously assess two items composed by other students. Then, there are eight trials formed in the whole class to proceed the next phase. With the display of the results of the peer-assessment on their Table PCs, they discussed face-to-face to elaborate their evaluations, choose two items as their small group items and revise them before submitting. Next, two trials were formed as a large group. Four large groups were formed in the phase. The peer-assessments and item choosing were repeated again. Because of absences and the problems with the connection between a few devices and the server, only seven items were sent to the phase of class-wide discussion. It totally took two hours to finish the procedure of AGQ.

According to our observation, the activity was engaging and they participated in actively through the process. Unfortunately, because most participants were unfamiliar with the operations of the system, much time was spent on trying to find out how to operate the system correctly. Refinement of the system is needed for ensuring smooth run of AGQ procedure.

We note that questions generated in this experiment were mainly fact-based questions. Many stems of the items are excerpts selected from the important parts of the learning material. Students also use concepts which are titles and sub-titles of sections and subsections, respectively, in the learning material. Also, they adopted some sentences in the presentation given by the teacher at the beginning phase. We also noticed that there were substantial number of similar Q&As generated by different students in the experiment.

SUMMARY

AGQ is a model of CSCL testing how student learning can be enhanced in 1:1 classroom. The current version of AGQ applies PEM and involves one DCC process: individual Q&A generation, self-assessment and peer-assessment, small group conflict resolution and modifications to reach common consensus. Finally a teacher-led class-wide discussion enables students to have a global view of the learning material digested by the class. A trial test was performed with the system and some observations were discussed. In next round of study, we shall incorporate guided questioning strategy to facilitate student understanding of the material and encourage and scaffold them to construct higher-level questions, not just factual questions (King, 1992, 1997). And some evaluations will be conducted at the next stage, such as the students' perceptions of processing the procedure of AGQ and the use of the technology, how usefulness and effectiveness of the procedure of AGQ and the support of software.

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