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Design and Development of an Online System in Support of Teaching-by-Questioning in Classrooms

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Abstract: An online system supporting a teaching-by-questioning strategy in classrooms was developed. The most distinctive designs of the system (i.e., the delay of participants' response display at the instructor's control, and the re-open of the response space when the accuracy rate falls between certain ranges) were explicated. Data on the perceived usefulness and ease of use found that more than 90% of the participants agreed that the use of the developed system to support the teacher's in-class questioning helps their learning of the course material, and that the system is easy to use.

Keywords: Active learning, classroom activities, online learning system, teaching-by-questioning

1. Introduction

1.1. Background of this work

Contemporary educational paradigms stress active information processing and meaningful knowledge-building on the part of the learner (Slavin, 2014). Current perspectives on educational assessment highlight the beneficial effects of continuous, formative evaluation during the learning process (Brookhart & Nitko, 2014). Despite this, students at all educational levels tend to have passive learning habits. Thus, it is important to design activities to change the status quote.

One such powerful teaching strategy is teaching-by-questioning. While this strategy has been practiced by many educators with effects attested (Chin, 2007; Gall, 1984), its implementation in today's classrooms encounters some difficulties. Particularly, due to the lack of appropriately designed support tools, it has been found that students' attentiveness to the teacher's in-class questioning and equal participation among students are rarely observed (Yu & Liu, 2015).

In an attempt to promote wider and more equal participation among students, and tap on the current generation of students as digital natives, researchers have explored the use of Moodle and Facebook (Deng & Tavares, 2013; Hogg, 2014; Liu & Yu, 2016; Yu & Liu, 2015). Even though encouraging findings support these tools for teaching-by-questioning in classrooms, the simultaneous and instant display of all participants' responses does not allow the strategy to reach its full potential. Many times students appeared to agree to already display answers. As a consequence, answering to the teacher's in-class questioning on these digital platforms tends to encourage group and convergent thinking from all participants.

1.2. Purposes of this work

To allow students' knowledge-building and sharing in classrooms not to be restrained by the pre-mature display of peers' responses to the teacher's in-class questioning, which may inadvertently induce group think, as implied by the conformity theory (Smith & Bond, 1993), an online system to address this problem is proposed. Specifically, the design and development of an online system in

support of teaching-by-questioning in classrooms by deferring the instant, simultaneous display of students' submitted responses at the instructor's command is the main goal of this project. Its learning potential and ease of use as perceived by the students are examined.

2. The Distinctive Designs of the Developed System (MAN: Minds-On! Act Now!)

In addition to functions supported in most online systems, two distinctive designs are in place in the system developed. First and foremost, rather than the instant display of respondents' answers to the teacher's in-class questioning (as is the case with Facebook and most synchronized online systems), MAN embeds the function of deferring the simultaneous display of participants' responses until the response time ends. For customizability, MAN allows the teacher to dynamically and quickly set or adjust each of the dimensions of each question posed—question types (true/false, multiple-choice or short-answer), response time, the number of options for multiple-choice questions (2~5), correct answer, showing/no-showing of students' responses to each question posed after the response time elapses, and showing/no-showing of students' names alongside their responses (see Figure 1).

Figure 1. Instructor question-setting space

Second, MAN allows the teacher to re-open up the response space, when the accuracy rate of the question to be answered is found to be between 30% and 70% for true/false and multiple-choice question types (Figure 2).

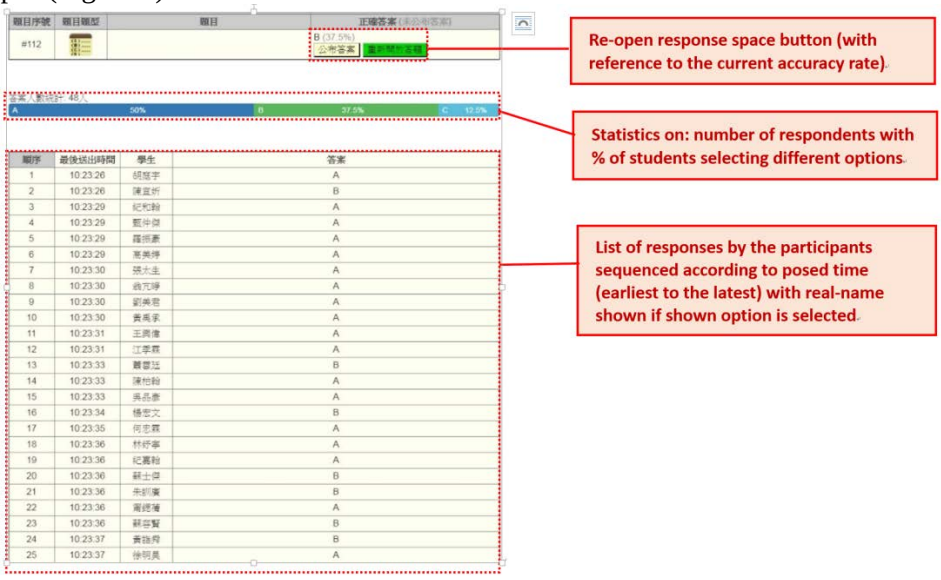

Figure 2. Re-opening student response space control panel with the accuracy rate of the question (top); showing of students' names alongside their responses/answers with posed time (bottom)

3. The Perceived Usefulness and Ease of Use of MAN

To provide some preliminary evidence on the learning potential and usability of MAN, it was used to support teaching-by-questioning in one undergraduate engineering course for six weeks. As a routine, teachers asked questions of different types during the instruction for formative evaluation. The participants (n=50) used any personal mobile device of their choice to respond to the teacher's in-class questioning during the study.

In light of technology acceptance model which postulates that perceived usefulness and ease of use of a technology as the two dominating factors predicting intention to use and future actual use of the technology (Davis, Bagozzi, & Warshaw, 1989), two questions targeting these two factors were devised for individual students' completion after their last interaction with MAN. Based on the 98% response rate, it was found that more than 90% of the participants strongly agreed (46.94%) or agreed (46.94%) to the perceived usefulness statement—'*generally speaking, the use of MAN to support the teacher's in-class questioning helps my learning of the course material.*' In addition, more than 90% of the participants felt that '*using MAN to participate in the teacher's in-class questioning in the course as*:' very easy (42.86%) or easy (51.02%). Not a single participant disagreed with MAN's usefulness for supporting learning, or felt MAN as very difficult to use.

While students' initial reactions to the integration of MAN for supporting learning is endorsed by the participants, issues with regard to how MAN supports learning and in what aspects are not known. Currently, the authors are in the process of analyzing students' provided explanations with regard to their experiences on MAN as compared to Facebook. Once these data analyses are completed, the relative advantages of MAN (specially, its distinctive designs) in support of learning can be better understood and assessed.

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