USING WEB-ENABLED MOBILE PHONES FOR AUDIENCE PARTICIPATION IN DATABASE LECTURES

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ABSTRACT

This paper evaluates the possible benefits of integrating audience response systems through mobile devices. Typically, existing clicker systems use proprietary radio remotes to send votes to a computer and display this information on screen. While proven to be a useful tool in lectures, adoption has been limited due to their up-front costs. Using mobile devices as a replacement is discussed as an alternative method by making it less intrusive and rootless. A prototype system was implemented to test these assumptions and was evaluated in a typical lecture with undergraduate students studying 'Database Fundamentals'. The students chose between this system and a typical clicker system and were asked to answer identical quizzes. While their feedback shows little benefit of the prototype over traditional systems, the mobile system offers tangible benefits to the lecturer in speeding up preparation of quizzes and setup time.

Keywords

Audience response system, class feedback, mobile devices.

1. INTRODUCTION

The ability to gauge student understanding is an important aspect of higher learning. If done well a "learning-conversation is constructed between the students and teacher," [1] allowing teaching to be at its best. However, the growing numbers of students per classes, some ranging to well over a hundred, causes this dialogue to become detached; teachers can no longer gauge the effectiveness of their lectures.

ARS (Audience Response Systems) have been around for over a decade with the first system, ClassTalk, becoming commercial in 1992 [2]. This system adapted graphing calculators, wiring them into a computer that received the responses. These systems show what answers participants selected to a multiple-choice question. The current market still uses similar systems with responses collated by a single computer. The clickers are no longer wired, instead often using wireless radio technology to send the responses. While more accessible to students as a whole, they continue to have a considerable overhead for the institution. A popular system such as TurningPoint can cost $2,800 USD (£1,731 GBP as of 07/02/2011) for 24 response clickers– around £70 each.

Many studies have shown that mobile devices as a method of student participation can be an effective method of gauging students' understanding. So far, however, there has been little discussion about using mobile phones for this task despite more students than ever having access to web-enabled phones and mobile devices. According to Hopke [3], over 98% of students own a mobile phone. Yet many in the academic community regard their use as a distraction during lectures and have enforced policies to stop students using them. The opposite view should be considered; used correctly these devices could promote learning.

2. MOBILE-BASED AUDIENCE RESPONSE SYSTEM

2.1 Implementation

A web-based audience response system where students would use their mobile phone to participate, MARS (Mobile Audience Response System), was developed and tested within a university setting. The requirements of this application were not extensive but required much discourse between student needs and that of the teachers who may use this.

The operating environment was a significant challenge and moved the operation of this system to a web server instead of being a standalone product like others. While a change of practice from most of the products used in this environment it only follows the trend of typically stand-alone products making it a 'cloud service' e.g. Google Docs.

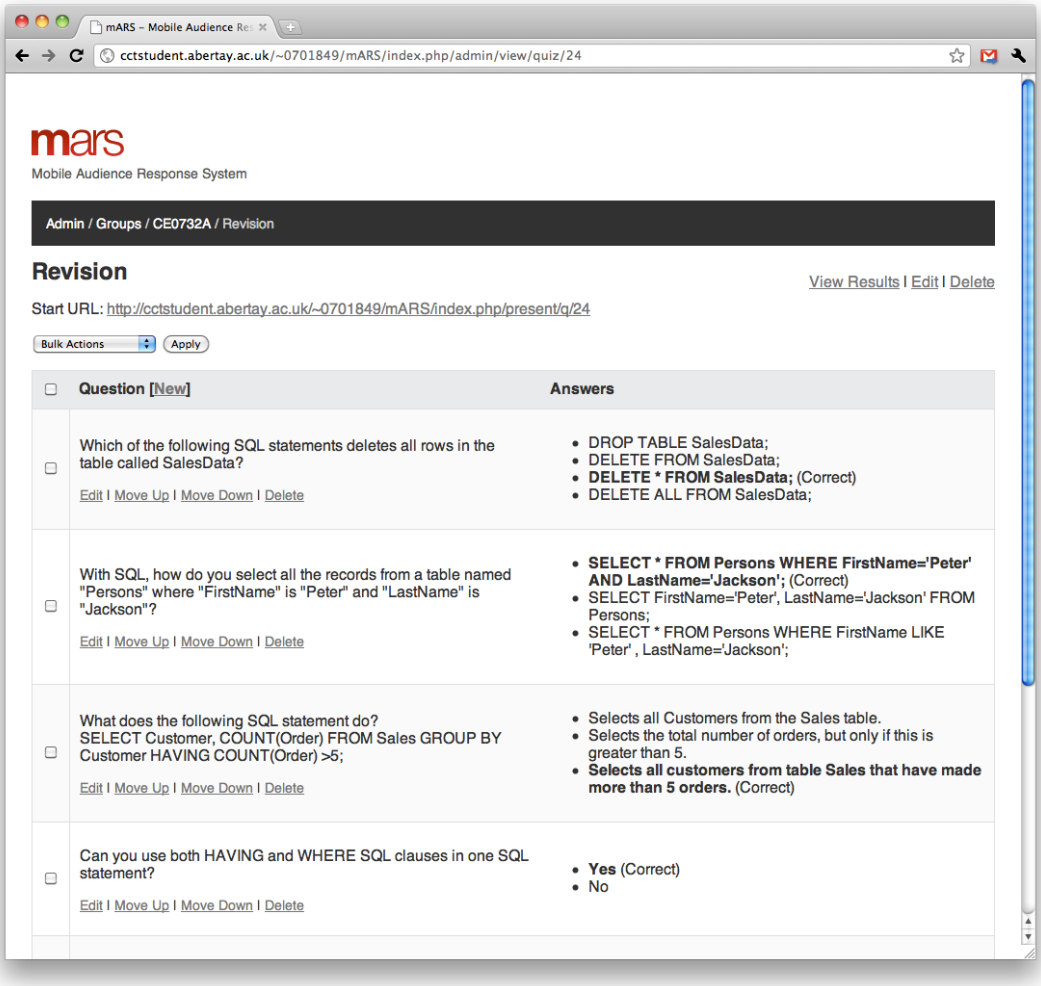

Figure 1 – A typical interface for presenters to edit quizzes before presentation.

For MARS, three distinct component applications were developed. First, and perhaps most significant, was an application that would allow entry and editing of a quiz split into distinctive groups for differentiation as shown in Figure 1. Secondly, a method of presenting the quiz questions and the results during a class was also required (Figures 2 and 3). This component also stores the results (anonymously) for later review by the lecturer. The third component allows participants to enter their vote on their device (Figure 4).

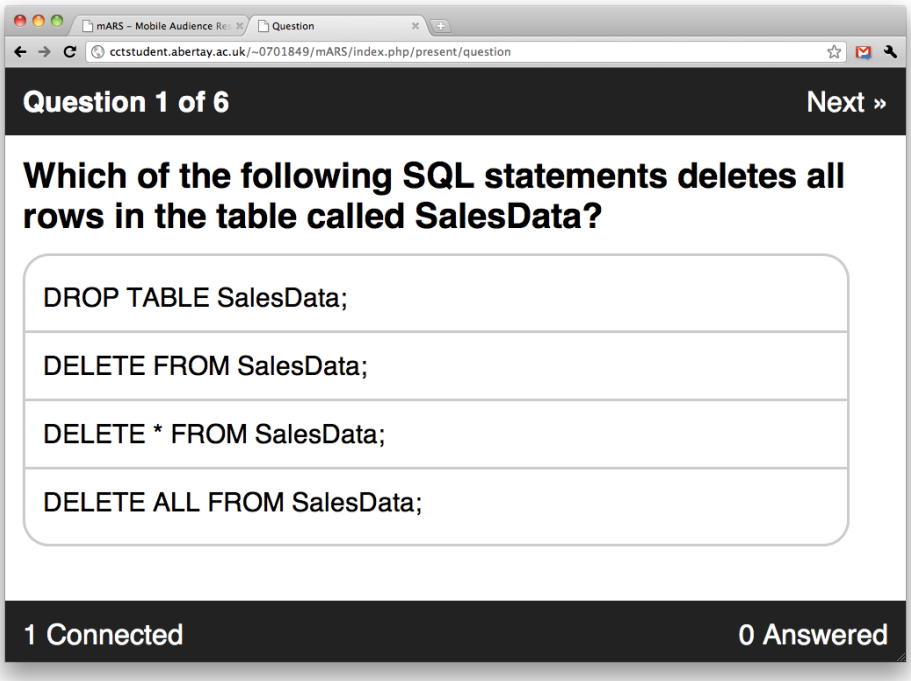

Figure 2 – Interface displayed on the presenter's display & projector.

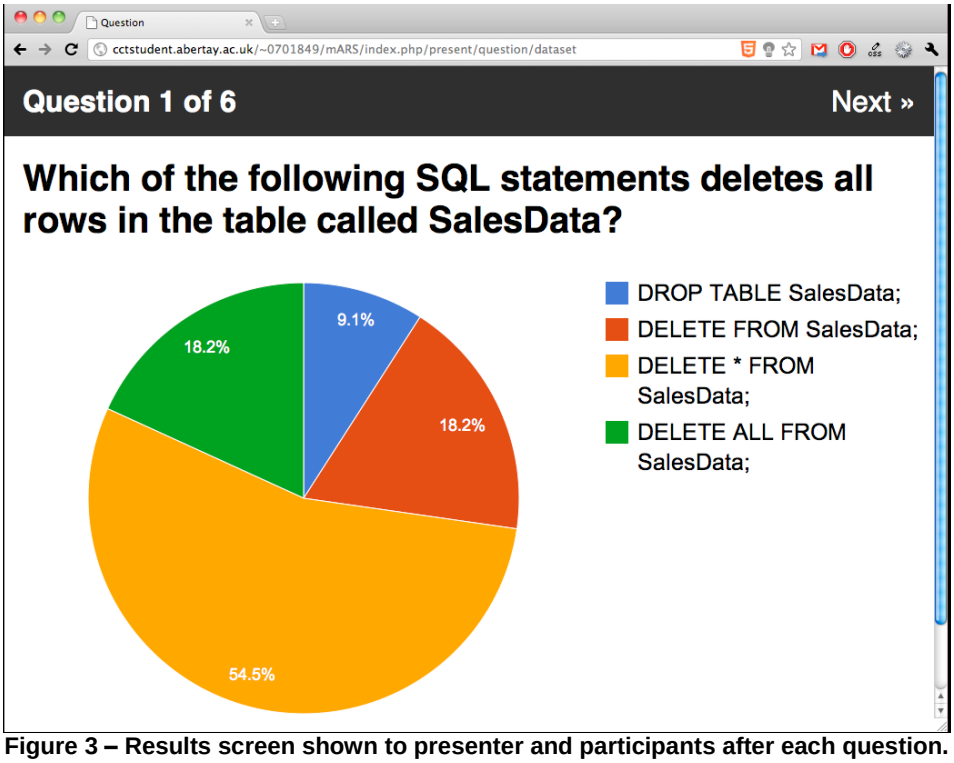

Figure 3 – Results screen shown to presenter and participants after each question.

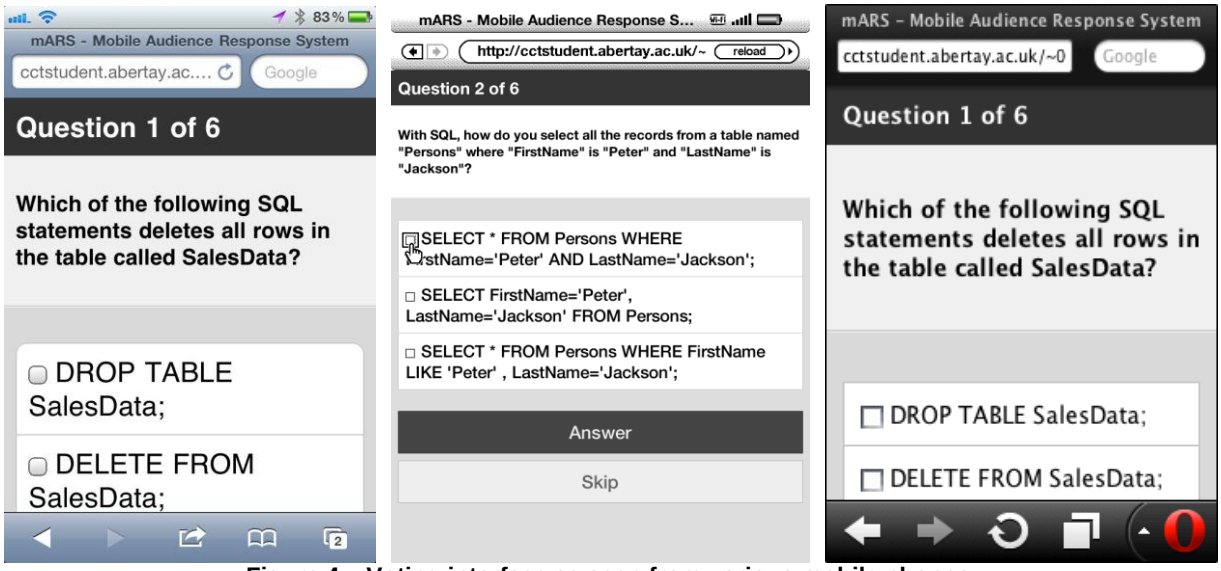

Figure 4 – Voting interface as seen from various mobile phones.

2.2 Evaluation

Evaluation of the mobile system focused initially on two aspects. The student participants' ability to use the device was notably the most important. The myriad of differences between phone devices and makes alter possible speed and determine technologies in use. Teachers themselves have to use the system and the need for speed, efficiency and clarity is of great significance at each step of the process.

The system was evaluated against the TurningPoint audience response system as a baseline. To evaluate the system from the student perspective a sample group was invited to participate during a lecture. This group consisted of approximately 25 first year undergraduate students studying "Database Fundamentals", containing typically male students with high computer literacy. Each student was given a choice between using TurningPoint with a borrowed clicker or the MARS system with their own mobile device. 56% of the participants chose to use their own devices, mainly mobile phones but also one or two laptops.

The two systems were enabled simultaneously with the lecturer switching between the two throughout. The questions and answers on these devices were kept identical and had been chosen by the lecturer as appropriate to the lecture content. During the test, the responses remained similar for the majority of the questions.

After this field test, students were asked to complete a questionnaire, which included technical details regarding their mobile phone capabilities and their evaluation of the system they used. The questionnaire was worded slightly differently depending on the system used, though the questions remained almost identical. This questionnaire asked information regarding their educational background and understanding, to confirm the mismatch discussed in the literature, as well as their opinion of either system. No data from the developed system was used for the evaluation as it is system performance, not student performance, which was to be evaluated.

3. RESULTS

3.1 Phone Properties

A large amount of credence in this research depends on the wide availability of mobile phones in the classroom. This research backs up claims made by Hopke [3] with only one participant (4%) not owning a mobile device. However there are issues with the number of students with a data connection, dropping down to 68%.

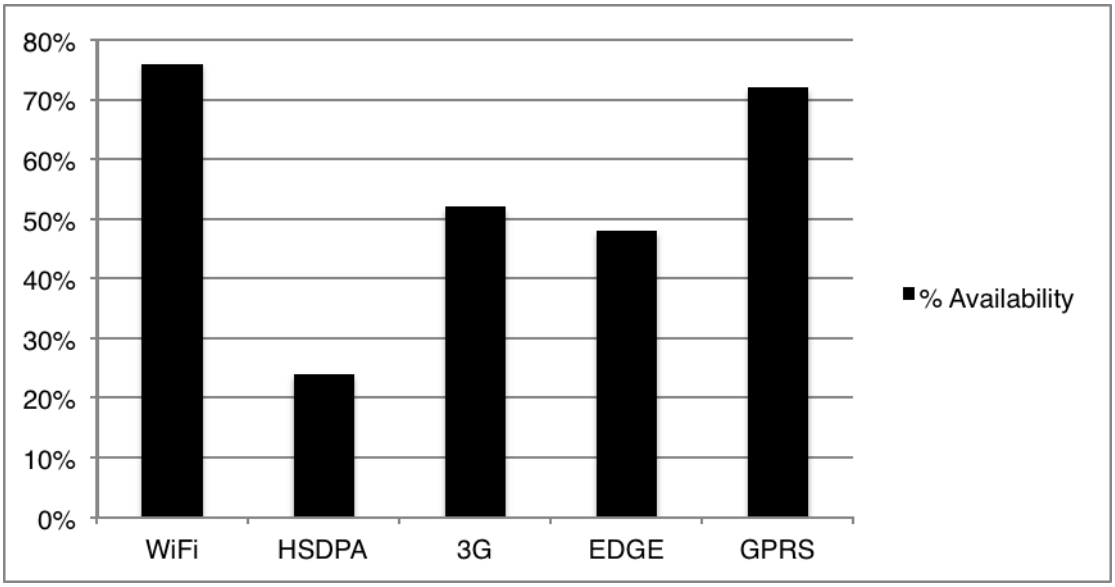

Figure 5. Data capability of participant mobile phones. Horizontal axis ordered from fastest to slowest relative data speeds.

Figure 5 shows the data capabilities of those with mobile phones during the study. The speeds of the mobile phone are the relative speeds which the user would experience during the voting process in a lecture. The ubiquity of WiFi capability reduces the worry of those who may not have a data connection, and provides a fast alternative to other data methods. GPRS however is significantly slower and the results show that participants who used GPRS did not enjoy using the system as much as others.

There is still a small disconnect between those who have a phone who do not have a fast enough connection to use this system and as such there is a concern. This minority may feel excluded from its use in classrooms due to their inability to participate. While other web devices could be used, such as laptops and other Wi-Fi capable devices, these students would have to own one to participate unless some could be loaned to these students.

3.2 Participant Backgrounds

Typically the participants did not report general difficulties with their classes, but around 32% had issues with paying attention to lectures and a similar percentage of students found it difficult to gauge how others understood the material. Just over half the class admitted they found it difficult to ask questions during lectures.

The audience response system engaged these students. While a large number had previously noted that they had no issue concentrating in class, 80% believed that they had paid more attention than in a typical lecture. Johnson [4] states similar rates of engagement, with roughly 88% of their respondents claiming that clickers kept them engaged during class.

3.3 System Comparison

Speed is an important factor in these systems on both student and lecturer applications. While student speed has already been mentioned, the time required for setting up questions to presenting the quiz should also be tested.

Both systems were timed as the questions from a source document were copied into each application. TurningPoint incurred a heavy overhead as it had to be installed on the computer before writing quizzes and required the hardware to be connected before any presentations could be created. Creation of the test quiz used in this study took roughly twenty minutes. While a quarter of that was time spent installing the software itself onto a new machine, the other fifteen minutes consisted inputting information and formatting that information into a typical Microsoft PowerPoint slide. MARS took significantly less time. Text could be copied and entered into the system without worry of formatting and in full, for the example six-question quiz, took roughly three minutes to complete. No installation was required.

The critical number of TurningPoint clickers was not reached during the test but the limitation was apparent. The number of voters using the system is limited by the clickers available, and only one quiz per system could run at one time. Using MARS could theoretically eliminate this issue, possibly allowing hundreds of simultaneous quizzes (in different locations) with thousands of respondents, limited only by the web server's capabilities.

Results were displayed similarly across both devices. The resulting data was displayed differently - the TurningPoint system uses a bar chart, while it was decided early on to use a pie chart for MARS - but did produce similar results. Initially, a drawback with MARS was that this system only showed the answers which had received votes while TurningPoint showed all values, even if null. This issue was easily overcome after the experiment through a workaround, so that null-result answers are now displayed beside the graph for reference.

Delivering results to participants after a quiz becomes carefree. Presenters often provide slides before a lecture. With TurningPoint, these slides have to be exported and saved again to include the results of the votes. On the other hand, results from MARS are stored automatically, and are available to all participants right away through the same link in the presentation. Presenters have this and extra functionality, as they can see results each time they use the quiz individually and together with little effort.

Student preference between the two systems was surprisingly fixed with participants keeping preference of their input system after the test was completed. A small proportion of the participants using the mobile system would prefer to use a clicker instead, with those respondents experiencing the slower data connection speeds. 8% of total participants would use either system.

The large number of students who were capable of running MARS on their device yet choosing TurningPoint was unexpected. Reasons for this remain unclear. While it may be due to the perceived professionalism of the chosen ARS over a student-built MARS, this is merely speculative. Participants rated MARS on par with TurningPoint and welcomed either into their education, as they believed both could assist in their learning. Not knowing why participants chose either system was a significant weakness of this research that was overlooked. If such information were known, it would help to improve future systems.

Notably there was a divide between participants over the questions themselves being displayed not only on the lecture monitor (TurningPoint) but also on their input devices (MARS). Those who had access to this feature found it overall a useful addition, with 71% agreeing that it was either very or relatively useful. On the other hand the majority of TurningPoint users (63%) did not miss this feature and believed it to be of little or no use.

4. CONCLUSION & FUTURE WORK

The support for ARS by the student participants in this study confirmed reports by Beatty [1] and others that students enjoy using such systems. However, the ability for mobile use of these systems may not yet be as widespread as hoped with 20% of participants not having a data connection. While this could reduce the ability to participate in such quizzes, the ability to observe is not hindered; non-participating students could still engage with the question but not have a casting vote.

For the lecturer, the availability of an easy-to-use web-based system is a major benefit. Inputting data not only became more convenient but extremely rapid, reducing lead-time significantly, and perhaps more importantly the setup time during any classes where it may be used was much reduced.

Results became easier to access for students. If the link to the quiz is included in the presentation, participants can view their resulting dataset quickly and easily. With TurningPoint this takes several additional steps, requiring exporting and uploading of slides manually.

While this study shows that using an ARS may be better than none at all, there is a caveat. Although use of a system would be widely accepted—using it as a method of monitoring progress of individual students may significantly reduce adoption. Also there was a drop between system performance and affordability for MARS and TurningPoint. The possibility of making an ARS integrate with a MARS to allow interaction on both devices may yield better results if at all possible.

These systems build a method of giving a presenter the means of retrieving feedback from an audience. In a higher education setting, this holds promise of reducing issues in student retention and understanding. It does not however solve one issue that may prove essential—expanding class sizes make it difficult for students to ask questions directly. If the system could also provide the audience a method to ask their own questions, perhaps along the ideas of the Live Questions tool [5] this would reconnect the 'learning-conversation' [1] to a fuller extent.

This research was conducted on a typically computer-centric student group; their high computer literacy may deliver different outcomes of evaluation. If this was applied to other diverse and larger groups a different picture may be found.

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