PRS - Six Years After its Introduction

Cue, Nelson

phcue@ust.hk
Department of Physics &
HKUST College of Lifelong Learning
The Hong Kong University of Science and Technology

ABSTRACT

A low-cost wireless electronic learning tool called the Personal Response System (PRS) that facilitates active engagement in a large class by enabling each and every student to answer questions in private was developed and made available for campus-wide usage at HKUST in 1998. Its unique features include 1) student transmitter handsets tagged with a 9-digit ID, 2) this 9-digit Student ID accompanies the signal sent each and every time the student presses his/her handset to answer a question, and 3) a handset having a 10-digit keypad plus two additional modifier keys providing a selection of 30 different answers. This combination of low-cost, unique features, and campus-wide applications provided the impetus for making PRS available outside the HKUST. Today, six years later, the large scale adoption of PRS can be found in North America including in such institutions as the University of Massachusetts at Amherst, Harvard University, North Dakota State University, Arizona State University, University of California at Berkeley, Oregon State University and University of British Columbia. Early users in the UK are the University of Strathclyde and University of Glasgow. Other users include institutions in Germany, Italy, Greece, Turkey, Australia, Indonesia and China. Here we review the factors that contributed to its recent widespread usage and the developments that could further increase its popularity.

Keywords

Personal Response System, immediate feedback and reinforcement, active learning, handsets, multiple-choice questions, interactive engagement, contingent teaching

INTRODUCTION

Learning needs inspiration, big or small, and inspiration cannot be scheduled. Yet we teach using regularly scheduled hours to a class of students that is increasing in size as the years go by. Fortunately, there are tools available for the classroom that provide immediate feedback and reinforcement to the learning process and, thereby, increase the chance for learning inspirations to occur. One such tool is the Personal Response System (PRS) developed at HKUST about six years ago [1,2]. Note that the same tool

provides immediate feedback and reinforcement for effective teaching as well.

The PRS is a wireless electronic learning tool that facilitates active engagement in a large class by enabling each and every student to answer questions in private. It is based on the well-established infrared technology similar to that of the remote controller for TV and, therefore, is relatively low-cost. Its unique features include 1) student transmitter handsets each tagged with a unique 9-digit ID that encourages individual ownership, 2) this 9-digit Student ID accompanies the signal sent each and every time the student presses his/her handset to answer a question, and 3) a handset having a 10-digit keypad plus two additional H/L modifier keys for indicating high or low confidence on the accompanying answer. The signals are registered in a line-of-sight receiver or several of these in series connected to a personal computer. The working principle of PRS is illustrated in Figure 1. The teacher poses a multiple-choice question by any convenient means. The students respond by pressing their answers on their handsets within the pre-set time interval (a minute or two is usually sufficient for a class of 100) specified by the teacher. The successful reception of each signal is acknowledged by a flashing box in an array projected on the screen that shows the corresponding student ID or the equivalent identifier. At the end of the interval, the individual responses are recorded in the computer. The teacher decides whether or not the tabulated results are displayed as a bar-graph immediately, later or not at all, and whether or not the individual responses with the student IDs are included in the file to be saved.
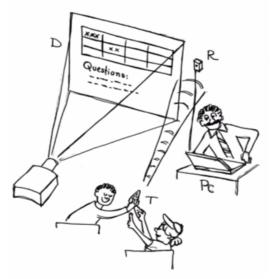

Figure 1. A cartoon illustration of the PRS in operation

HOW EFFECTIVE AND UNIVERSAL IS THE LEARNING TOOL?

The traditional one-to-many lecture, especially for large classes, is considered by many as one of the weakest points in the teaching at many universities because of its lack of interactivity. Recently, a satisfactory remedy adopted by an increasing number of lecturers is to intersperse their lectures with well-thought-through questions for all students to answer using, for example, a system like the PRS. The effectiveness of such

an 'interactive engagement' approach that has immediate feedback and reinforcement for the students has been well documented. For example, in the teaching of first year mechanics, the approach has been shown to have a large positive effect, more than doubling the measured learning based on standardized test results [3], and to work across a large number of institutions [4]. A recent study by Draper & Brown [5] reported the approach to be applicable across many disciplines, and that the use of handsets was judged by both learners and teachers to benefit them. They further emphasized the equally important feedback to the teacher about the state of understanding by the group, and coined the term 'contingent teaching' to describe the adaptive teaching that takes explicitly into account the learners' understanding as reflected in the feedback.

Another measure of the effectiveness of the PRS is the large number of hits obtained when one does an Internet search. While many PRS users are single unit or several units of an institution, an increasing number of institutions are making PRS available campus wide. In addition to HKUST (Hong Kong) and the University of Glasgow (UK), the list of campus-wide users includes the University of British Columbia (Canada), the University of Massachusetts at Amherst (USA) and North Dakota State University (USA). The webpage of North Dakota [6] is interesting as it highlights the student survey results of their pilot study. These results are reproduced in Table 1. Similar results are obtained in other similar surveys.

To 'I do more thinking during PRS classes than in lecture classes,' **82.1%** respondents agreed or strongly agreed.

To 'some PRS questions make me try hard to make sense of the subject matter,' **89.7%** agreed or strongly agreed.

To 'I prefer the more traditional lecture approach over the newer PRS approach,' **91.4%** disagreed or strongly disagreed.

Table 1. The NDSU pilot project: student survey results

The Internet search also yielded the surprise finding that textbook publishers are now listing the PRS in their product line [7]. These firms have learned about the importance of interactive engagement and, therefore, are making available textbooks that contain multiple-choice questions and bundling with each either a PRS handset or a rebate coupon for its purchase.

WHAT NEXT?

Several factors are now contributing to the upsurge in the adoption of PRS for interactive engagement in the classroom. Firstly, there is the usual incubation period for

any new technology to be accepted even for the obviously useful one, and we have now passed that period. The other factors include:

1. Making available a Java version that complements the original Visual Basic version so that the PRS software is no longer platform-dependent.
2. The Java software has several new features:
    o Questions can be displayed in a richer texture;
    o A separate and independent display window for the instructor;
    o An option to pose questions requiring a numerical answer; and
    o A self-paced test-taking mode of operation whereby students answer a list of questions in any order by keying in sequence the combination of question number and associated answer.
3. The distribution of PRS handsets with their unique 9-digit student ID through university bookstores very much like the handling of textbooks including buy-backs and resells.
4. Publishers increasingly incorporating multiple-choice type questions in their textbooks and bundling the textbooks with either a PRS handset or a rebate coupon for its purchase. They even provide free PRS receivers to the institution that adopts these textbooks.

The last two factors above may seem trivial but have profound economic and logistical impact. These make the financial cost for implementing interactive engagement to be spread out among many parties so that it is no longer a burden on the institution or teacher. The time needed to set up each PRS session is no longer an issue since, with student ownership, there is no longer any need to distribute and collect handsets, and the receivers can be mounted permanently in all classrooms.

SUMMARY

Six years after its introduction, the PRS is becoming recognized and accepted as a relatively low-cost, universal, and highly effective classroom learning tool. The immediate feedback and reinforcement provided by the interactive engagement it facilitates during a lecture help increase student learning and enable contingent teaching that adapts to the level of the students' understanding then and there. In the near future, a scenario in which every student carries to class a PRS handset like a pen and paper set may not be too farfetched.

REFERENCES

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[7] See, e.g.,
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