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Using Technology to Increase Student Participation in the Learning Process

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Abstract
During the last decades active learning has gained great interest in the academic community. Several strategies have been used to increase active student participation in the learning process. This paper outlines a means of incorporating assistive technology in the active learning scenario. The topics discussed are use of class performance equipment, creation of a questions database, and obtaining satisfaction results. This technology has been proven to work in two ways: first, students pay more attention to the class in order to correctly answer questions and, second, continuous improvement of the class can be achieved due to immediate assessment, since the professor can quickly address misconceptions or misunderstandings.

Keywords
Active learning, Technology in the classroom, Formative assessment

1. Introduction

Teaching is not the same as learning and the fact that someone is teaching does not necessarily mean that someone else is learning. The student has to be involved in his/her own learning process. It has been demonstrated that delivering a good lecture does not necessarily mean that the student will learn. During the last decades, several researchers have emphasized the need for active participation of the student in the learning process (Dufresne et. al., 1996; Felder and Brent, 1996; McKeachie, 1986; Johnson et. al., 1991; Costin, 1972). Several strategies are carried out in order to increase student participation in the classroom; among them are the use of cooperative/collaborative learning, acknowledgement of diverse learning styles during class preparation, use of the Socratic Method, and incorporating laboratory experiences in traditional lectures among others. Technology can play a crucial role in facilitating and promoting active student participation in the learning process. as it is presented in this article.

The University of Puerto Rico at Mayagüez (UPRM) strives to provide faculty with the tools necessary to incorporate different strategies into their classrooms. This is done through the Center for Professional Development. New faculty members are required to take a series of workshops which are open to all faculty members. Some of the workshops offered cover diverse topics ranging from Learning styles, Cooperative learning, Assessment, Construction of exams, Instructional objectives, to Effective teaching strategies. A broader initiative is the Best Practices Conference sponsored by the Alliance for Minority Participation held annually where interested educators can get to know about strategies for implementing best practices in education. IDEAL is an UPRM initiative to provide professors with orientation

concerning the use of the web to deliver courses via WebCT. These and other initiatives try to always improve educational strategies at the University.

Student involvement in the learning process enhances the quality of their education. During the learning process, students can organize new concepts, can incorporate new concepts into their previous knowledge, and can make the necessary corrections to previous misconceptions related to newly acquired information (Abrahamson, 1999; Poulis et. al., 1997). This paper presents the use of a technology called the Class Performance System (CPS), consisting of a transmitter, receiver, and software designed to increase student participation in the learning process. A description of the system used is given, followed by a description of the course chosen for the implementation of the technology, a description of the questions developed, and the results of a satisfaction questionnaire.

2. Class Performance System – The Technology

The system consists of individual infrared transmitters given to each student and a receiver connected to a computer by an USB port or RS-232 cable; the receiver converts the infrared signals into digital data. Update for the software is free and also has technical support. The equipment is commercially available (eInstruction, 2006). The students are provided with a simple user friendly interface to choose an alternative by just pressing one of the buttons on the transmitter. The results can be obtained by simply choosing an option on the computer. Class results can appear as a bar or pie graph. The correct answers can be pointed out without infringing on student privacy. The system allows an anonymous response to be incorporated, giving liberty of participation to the shy and other individuals with low self-esteem. Our classrooms have computer projectors and a computer is either installed in the classroom or can be supplied to the faculty member. This infrastructure allows for easy implementation of the CPS technology.

3. Scope of work

Improving the learning experience of students in fundamental engineering courses is of paramount importance. The CPS system was used in three General Engineering courses. These were the Algorithms and Computer Programming course (INGE 3016) offered to all Engineering students during their sophomore year, the Engineering Materials course (INGE 4001) and the Materials Science for Electrical Engineers course (INGE 3045) offered to both electrical and computer engineering majors. Both materials courses are offered to sophomore and junior year students. The objectives of this initiative were to determine if the CPS system would increase student participation, if professor's would obtain immediate feedback of student understanding, and develop strategies for incorporating the necessary changes in class delivery.

The CPS system allows instructors to test student's understanding of a subject in a just-in-time fashion. The instructor asks key questions to assert student's understanding of a particular subject, students respond using the infrared transmitter, and the results are obtained immediately using a computer. The instructor immediately knows whether the subject was understood and, in case it was not, can explain it again using some other method. Students are so motivated that 100% participation is normal in contrast to the extremely low participation exhibited when using traditional methods. The immediate result of the use of this technology is a much better understanding of the subject.

4. Methodology

The first course chosen to prove the technology was (INGE 3016) Algorithms and Computer Programming. This is the first engineering programming course and it is very difficult for the students. About 20% of the students drop or fail the course. Could use of the CPS system in this course promote student participation in the difficult class and allow students and professor to make better use of their time. The questions for the course have to be prepared carefully because they need to test not only the

memorization of a concept but also its comprehension, application, synthesis, and evaluation. As an example, we present the following two questions; the first reviews a concept and the second is an application of the concept.

The scope of a variable refers to where it can be referenced to it in the program:

a. **True**
b. **False**

There is a function f1(), inside its body a variable int num = 5 is declared and initialized. In addition there is a global variable int num = 10, outside of f1(). If the variable num is sent to be printed from inside of the function f1(), the printed value will be:

a. **5**
b. **10**
c. **0**
d. **garbage**
e. **I do not know**

If the student knows the definition, then the answer to the first question comes very easily. But for the second question, the student has to both understand the concept of scope for a local and a global variable and know the difference between the scopes of each one in order to answer.

The other courses, (INGE 4001 or 3045), are loaded with content and for many students they are not interesting or pertinent for their interest. Similarly the question developed need to address not only the definition but also an application.

All crystals are perfect

a. **True**
b. **False**

The dislocation are not formed

a. **When a solidification process are carried out**
b. **When permanent deformation is carried out**
c. **When plastic deformation is carried out**
d. **At high temperatures**
e. **None of the above**

The construction of the questions is cumbersome. They should be at different levels and unambiguous. Using the CPS system was trivial, but generating the questions based on an active learning scenario proved to be the most time consuming aspect of implementing the technology.

A satisfaction questionnaire was used to determine student perception of the CPS technology. Similar questions have been used in previous studies (Everett, 1998). The questions or phrases used are the following:

1. The questions used with the CPS helped me to know which concept I did not understand.
2. The questions used with the CPS help me to clarify doubts of the covered concepts in the class
3. I would like this system to be used in other courses
4. I would like that the CPS will be used more frequently in this course
5. I pay more attention to class in order to answer correctly the questions of the CPS
6. Using CPS, the professor knew which concept needed reviewing and which one was not understood at all.
7. Sometimes I understood a concept better when I had to answer a question.

The students were provided the following scale to best describe their opinion about the above statements:

A. Agree

B. In Average agree
C. No agree

5. Results and Discussion

The results of the satisfaction questionnaire are presented in figure 1

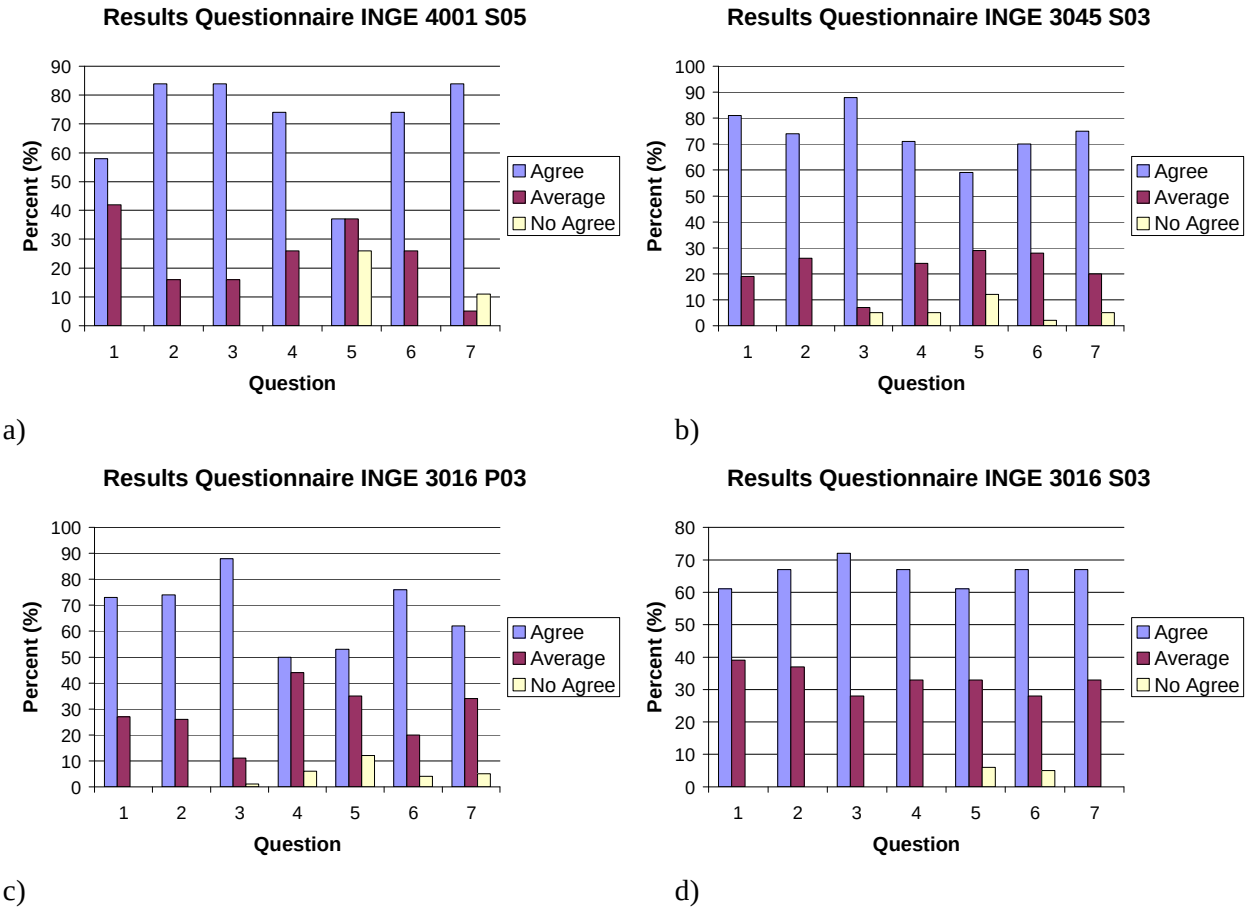

Figure 1: Satisfaction Questionnaire Results, a) Engineering Materials 19 students II Sem 05-06 b) Materials Science for Electrical Engineers 42 students II Sem 03-04 c) Algorithms and Computer Programming 66 students I Sem 03-04 d) Algorithms and Computer Programming 18 students II Sem 03-04

All the students participated when the CPS was used. The goal to increase student participation was met. At least they paid attention to determine what they were going to answer. Obtaining a responsible answer was what we wanted. A correct answer could imply that the student paid attention and studied. An incorrect answer could imply an ineffective concept presentation. The latter can be addressed with a different delivery or new presentation of the concept.

Statement number three of the questionnaire, "I would like this system to be used in other courses", received the highest score in all the groups. This shows that the students liked this technology.

All the questions are answered positively. One of the lowest is question number five which asks if they pay more attention in order to be ready to answer but even so most of the groups are over 50% in agreement. From this result we infer that some of the student may be guessing the answers. Our opinion

is that the most powerful learning strategy is the student's own interest and motivation. Even so we consider this a good response.

Sometimes a question was given and only five of 23 had the correct answer. This was a quick response which could be interpreted as students not paying attention to the concept or not understanding the presentation. The experience, also, helped to identify misunderstandings and design better presentations because among the answers to questions were included typical misunderstandings. Answers provided by the students allowed the professor to determine immediately if the knowledge had been acquired and if not to repeat the concept again.

6. Conclusions

The Class Performance System (CPS) consisting of the transmitters, receiver, and software is an excellent tool for incorporating assistive technology in the active learning scenario. Student participation was increased through active involvement in the learning process. The CPS is a very good formative assessment tool which provides the professor the opportunity to make adjustments in a just-in-time fashion providing a fast corrective action to help the student eliminate misunderstandings and misconceptions. Students like using the system and they would like it to be used in other courses.

Developing the questions and exercises to be used with the CPS is time consuming and should be part of a continuous improvement process.

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