

The Use Of PDAs As Classroom Interaction System: Instructors' Perspective

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Abstract. We have been implementing a web-based interaction system in which students use personal digital assistants (PDAs) to interact with their instructor in their physics/physical science lecture classes. In this paper, we discuss the instructors' implementation strategies, pedagogical approaches, and perceived effectiveness of the interactive teaching approach on students' progress, engagement, and achievement. In addition, we will document the impact of the interactive teaching approach on instructors' pedagogical orientation.

Keywords: interactive teaching approach, web-based interaction system, physics education research

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INTRODUCTION

Research had shown that interactive engagement teaching techniques seem to promote better conceptual understanding among physics students [1]. Electronic voting systems like "clickers" [2,3] have been used to enhance the interactivity of lectures especially in large-enrollment physics classes. In this system, students are typically asked multiple-choice type questions which they are required to answer by using their clickers. Recently, web-based interaction system using hand-held devices are becoming popular because of additional affordances [4, 5] like being able to ask open-ended questions.

We have been implementing a web-based classroom interaction system in which students use personal digital assistants (PDAs) to interact with their instructor in their physics/physical science lecture classes. Several instructors were recruited to try out the interactive teaching approach in their physics classes. In this paper, we discuss the instructors' implementation strategies, pedagogical approaches, and perceived effectiveness of the interactive teaching approach on students' progress, engagement, and achievement. In addition, we will document the impact of the interactive teaching approach on instructors' pedagogical orientations.

The web-based classroom interaction system has an instructor interface and a student interface that interact

with the server and the instructor computer using a wireless network (see Figure 1).

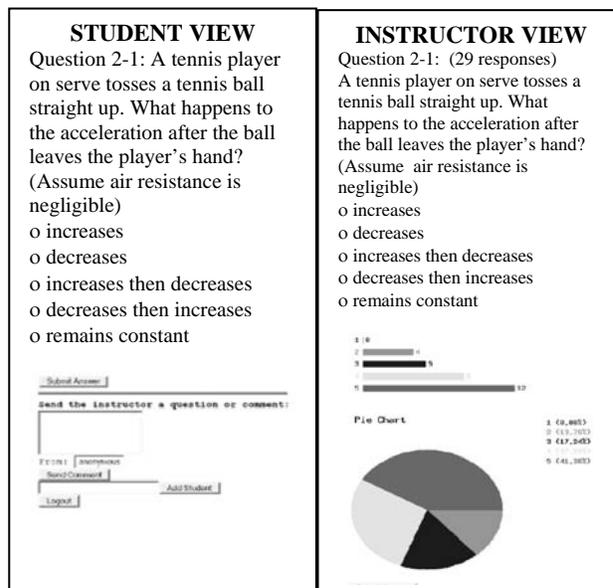


FIGURE 1. The Web-Based InClass Interaction System.

The instructor begins an *InClass* session and students log in using their personal digital assistants (PDAs). Any time after students have logged in they are able to send a question or comment to the instructor either anonymously or by name. The

instructor checks her/his computer periodically during the lecture to find any questions or comments that have been submitted and responds to them accordingly.

METHODOLOGY

Four faculty members (2 non-PER, 1 PER, and 1 Science Ed) were recruited to implement the interactive teaching approach using PDAs as classroom interaction system. These instructors were provided sufficient training on the use of the web-based interaction system. They implemented the teaching approach in algebra-based introductory physics/physical science courses for at least four weeks.

A questionnaire was designed and administered to the four UTPA faculty members who participated in the project. The purpose of the questionnaire was to obtain direct feedback about implementation strategies, pedagogical approaches, and perceptions about impact on students. The following questions were asked:

1. Course, semester, and student enrollment numbers.
2. Describe how the interactive PDAs were used in your class (include information about pre-class activities and frequency of use).
3. Describe the pedagogical approach used in these classes.
4. Describe what you did to create an environment where students were encouraged to interact and use the PDAs.
5. Describe the ways in which teaching this class was different from others you have taught.
6. What changes (positive or negative) did you notice in the students who participated in classes where PDAs were used (specifically address any changes in motivation, engagement, or achievement)?
7. What did you find difficult about teaching using PDAs?
8. Describe the ways in which your pedagogical approach has changed as a result of participation in this program.
9. What advice would you give to other faculty members who might be considering incorporating the use of this technology into their classroom?
10. Do you plan to use this technology in future courses? Why or why not?

The questionnaire was administered electronically and all individual responses were analyzed and categorized.

RESULTS

Below we present the results in terms of the variations in the implementation, pedagogical approach, and perceived effectiveness of the interactive approach in enhancing students' engagement and achievement, as well as implementation issues faced by instructors.

Variations In Implementation

The four faculty members were given the flexibility in adopting the use of the web-based classroom interaction system in their classes. This was deliberately done in order to investigate the variations on how the four instructors would adopt the interactive teaching approach in their classes. The interactive engagement teaching approach using PDAs as classroom interaction tools were used in classes with student enrollment ranging from 30 to 80 students. In all cases, the PDAs were issued before classes and returned at the end of class.

Three of the four faculty members reported using the PDAs daily or most every day and one reported use that was based on the content material presented in a given lecture. One faculty member reported integrating the PDAs in their lecture class as a mechanism by which students can ask questions, make comments, make observations or predictions, and answer or solve problems, while another reported using the PDAs as a means for students to answer questions in class and as a means to receive questions about content, homework, and tests. The remaining two reported using the PDAs predominantly as a method for students to respond to questions about course material. Implementation was slightly different for the four faculty, in that in that one person would have the students generate questions, another used a pool of available questions, and two prepared questions based on lecture material. In all cases, faculty indicated positive implementation, with reported use being for two primary reasons: (1) as a formative assessment tool, and (2) as a means to increase engagement and achievement.

Pedagogical Approach

Three of the four faculty members described their teaching approaches as interactive while one described it to be more traditional lecture. The following are self-described approaches.

1. Active Learning: demonstration experiments that involve student volunteers, asking students to predict the experiment outcomes

- first before conducting each experiment.
(*non-PER faculty 1*)
2. Interactive: combining interactive lecture-demonstration and peer instruction using the personal digital assistants (PDAs) as interaction tools. (PER faculty)
 3. Lecture: emphasizing the physical concepts underlying the chapter material.
(*Non-PER faculty 2*)
 4. Interactive: lectures and lecture demonstrations, handouts to maximize time with students, small-group discussions, and group assessments.
(*Science Ed faculty*)

When asked about how their pedagogical approach had changed during the course of the project the faculty replied in the following way:

PER faculty: “I became more convinced to use interactive approaches.”

Non-PER faculty 1: “I became more aware of asking the right/appropriate questions and of gathering the students’ prior knowledge.”

Non-PER faculty 2: “I noted increased student participation but recognize my largest obstacle is poor preparation of students entering the class.”

Science Ed faculty: “I pay more attention to what the needs of the students are in the learning process rather than what I would like to accomplish in each class.”

It was reported by majority of the respondents that teaching classes in a traditional manner (prior to using PDAs) did not allow them to know what students understood, especially at the individual student level. The use of PDAs combined with interactive approaches changed that and “made student learning more friendly.”

Specific strategies were used to complement the PDAs and foster an interactive learning environment. Those strategies included:

- Encouraging students to work with a neighbor in solving problems and giving answers on the PDAs
- Making students aware of how other students are thinking by showing statistics of PDA responses
- Typically giving questions in exams that are similar to the questions used during classroom work with PDAs
- Allowing points for participation
- Having students share a PDA and collaborate on providing answers
- Making time for group discussions and group assignments
- Providing extra credit for students who participate with PDAs

For the most part very little was identified as problematic or difficult about teaching using the PDAs. Two of the faculty members thought that classroom management (the distribution and collection of PDAs) was the only problem. Two reported that using PDAs required significant effort in preparing questions that complement the material and that they needed to be more scripted so that questions were germane to discussions. Though, it was noted that it was encouraging to see greater participation, especially from those in the last row in large lecture classes.

Student Progress, Engagement and Achievement

All four of the faculty members indicated that the PDAs served as a mechanism for monitoring student progress and provided valuable formative feedback about student performance. The information gained from the PDAs provided instantaneous feedback resulting in insight into conceptual difficulties and students’ understanding and misconceptions. Thus, allowing the professor to determine if further clarification or a modified approach was needed. One person reported that in instances where a quick analysis revealed that the majority of students got an answer wrong, they would further clarify, address misconceptions, and then repeat the PDA question process. The result was that “usually the correct response rate is near 100% the second time.”

Improved student engagement and achievement were reported by all four faculty members. Details of the investigation of the effectiveness of the interactive teaching approach using PDAs as classroom interaction system is reported in our previous paper [5].

Faculty members indicated in the questionnaire that students “*were paying more attention to my lectures because they knew I would be asking them questions,*” that they “*saw a high level of response when students could answer questions anonymously,*” and that “*many pertinent and insightful questions were asked that would have been unasked without the PDAs.*” It was also reported that students very much like using the PDAs and that overall students appeared more engaged.

The following were reported as changes noted in students in classes using interactive approaches with PDAs:

- Paid more attention
- Performed significantly better
- Showed high levels of response
- Were less timid (PDAs allowed them to respond anonymously)
- More responsive
- More enthusiastic
- Not scared to ask questions
- More motivated
- More engaged
- Improved achievement

Challenges Faced By Instructors With The Use of PDAs As Classroom Interaction Tools

Overall, all four faculty members reported that using interactive approaches and PDAs in the classroom was a positive experience. Three of the four plan to continue, with the fourth (non-PER faculty 2) indicating that he/she prefers to use a device with a larger screen so that students can use Mathematica. They caution that the technology per se will not improve student learning, how you use it in the classroom is critical to success.

The use of the interactive teaching approach with the use of PDAs requires careful planning ahead of time in order to make a more efficient and effective implementation. One the challenges identified is the construction of good questions on the fly if an instructor needs to further probe students' understanding or provide follow up questions to scaffold students' learning.

Organization around the distribution and collection of devices is another obstacle that faculty feel future implementers will have to overcome. According to two of the respondents, these obstacles are not insurmountable. Future implementation where students use their own Wi-Fi devices could alleviate organizational problems and the development of a library of questions might help with preparation time.

Faculty Recommendations About The Approach

For the most part the faculty members indicated that they would tell others that it is worth the effort. In their words,

"It is very convenient and a good way to generate feedback about prior knowledge."
(non-PER faculty 1)

"Nothing works better than knowing what your students are thinking."

(Science Ed faculty)

"Formative assessment is very important if we want to maximize student learning."

(PER faculty)

"One can consequently improve his/her teaching." (non-PER faculty 2)

CONCLUSION

Overall, our preliminary data suggest that the use of an interactive engagement teaching approach using personal digital assistants (PDAs) as classroom interaction devices seems to promote positive attitudes among faculty irrespective of their field of expertise (PER or non-PER). It is perceived that the interactive teaching approach improves student engagement and achievement. Finally, the use of the web-based classroom interaction system is viewed to be useful in doing formative assessment of students' understanding in physics/physical science classes.

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