Dear Award Committee

We are submitting a nomination of Classroom Presenter 3 for the 2008 Premier Award. The Classroom Presenter 3 software has been written at University of Washington, and we hold the copyright for Classroom Presenter 3. We are authorized to submit this courseware for the competition.

I have directed the Classroom Presenter project, and my contact information is as follows:
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NEEDS is granted rights to be a non-exclusive distributor of Classroom Presenter 3.

Here is a short description of Classroom Presenter 3:

Classroom Presenter is a Tablet PC-based interaction system that supports the sharing of digital ink on slides between instructors and students. When used as a presentation tool, Classroom Presenter allows the integration of digital ink and electronic slides, making it possible to combine the advantages of whiteboard style and slide-based presentation. The ability to link the instructor and student devices, and to send information back and forth provides a mechanism for introducing active learning into the classroom and creates additional feedback channels.

Sincerely,

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Classroom Presenter 3
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Abstract
Classroom Presenter is a Tablet PC-based presentation system that facilitates active and collaborative learning in the engineering classroom. When used as a presentation tool, Classroom Presenter allows the integration of digital ink and electronic slides, making it possible to combine the advantages of whiteboard style and slide-based presentation. When student devices are used, the ability to send information back and forth between students and instructor provides a mechanism for introducing active learning into the classroom and creates additional feedback channels.

Classroom Presenter has been used extensively as a presentation tool in engineering classrooms since spring 2002 in classes ranging from large freshman lectures of hundreds of students to small graduate seminars and recitation sections [3, 5, 6]. Classroom Presenter has also been deployed widely with student devices in a variety of engineering courses at many institutions including efforts in international and distance education [1, 4, 8]. The system (including source code) is freely available [20] and has been extended by several researchers at other institutions [9, 12, 13]. We estimate usage by thousands of instructors worldwide1 and impact on tens of thousands of engineering students.

1 Improving the engineering classroom
1.1 The need for rich and flexible presentation tools
Instructors of engineering courses often teach using prepared slides displayed with a computer and data projector. Advantages of such systems include the ability to structure material in advance, prepare high quality examples and illustrations, and easily share and reuse material. Engineering instructors especially benefit from the ability to switch conveniently between slides and web content or other computer-based tools such as simulations or a programming environment. Computer-based systems are also well-suited for archiving and transmitting presentations, e.g., for distance courses. However, these advantages come at the cost of decreased flexibility during presentation – especially in the capacity to adjust the lecture based on audience reaction. Many instructors find this lack of flexibility so stifling that they refuse to use computer-based presentation systems, opting instead for manual systems (such as overhead projectors or document cameras) that support high quality handwriting over slides, enabling the instructor to augment prepared materials with supplemental text or diagramming. The ability to annotate materials is particularly important in engineering, where diagramming appears in many types of instruction: from sketching a force diagram in mechanics to annotating a circuit diagram in digital design.

1.2 The need for interaction and feedback
A successful engineering classroom requires consistent efforts at communication and participation by both students and instructors. Students should be actively engaged in the material – staying focused on problems posed by the instructor, and interacting with the instructor and their peers to further their mastery of the subject. At the same time, instructors should frequently interact with students – assessing students’ level of understanding and providing feedback on student work. In engineering classrooms in particular, it is important for instructors to confirm that students can apply principles discussed in lecture to solve problems, and to provide timely feedback to students on their solutions or designs. Student answers can often take the form of complex diagrams such as process flow charts or structural diagrams – solutions that are difficult to express and discuss verbally without a visual aid.

1 Since January 2008, Classroom Presenter 3 has been downloaded over 7,000 times from our web site.
2 Classroom Presenter – a tool for the engineering classroom

We have developed and deployed Classroom Presenter [2, 7] a Tablet PC-based presentation and interaction system that supports the sharing of digital ink on electronic slides among instructor, student, and public displays. When used as a presentation tool, Classroom Presenter allows the integration of digital ink and electronic slides, making it possible to combine the advantages of whiteboard style and slide-based presentation. When student devices are used, the ability to send information back and forth between students and instructor provides a mechanism for introducing active learning into the classroom and allows instructors to easily assess student learning and provide feedback to students on their work.

In a typical class using Classroom Presenter with student devices (shown below in Figure 1), the instructor will begin with a slide deck she has prepared with Classroom Presenter in mind, including opportunities for inking and active learning exercises. As the instructor writes on slides, students receive a copy of the instructor’s slides and ink on their devices in real time. When the instructor reaches a slide where she has prepared an active learning exercise, she will introduce the activity, and then give students time to complete the activity - often encouraging them to work in pairs or small groups. Students complete the activity by adding ink or text to the copy of the slide on their devices, and submitting their work anonymously to the instructor. Submitted slides appear on the instructor’s machine in a separate “Student Submissions” slide deck (see Figure 1 below). The instructor can then preview the student submissions and choose student work to display and discuss with the class. The anonymity of the system makes it easy for the instructor to discuss common misconceptions without embarrassing the submitter.

![Instructor view](image1)

![Students view](image2)

![Public Display view](image3)

Figure 1: Interaction with student devices using Classroom Presenter. The system runs on instructor, student, and public displays, each with its own user interface. In the scenario shown here, the instructor presents a slide with an activity. The students write solutions to the activity on their Tablet PCs and submit their answers to the instructor. The instructor can preview the student solutions in a filmstrip (shown on the right of the instructor view) and then selectively show student answers on the public display for class discussion.
3 Impact of Classroom Presenter

3.1 History

Classroom Presenter version 1.0 was implemented by Richard Anderson and Steve Wolfman [14] while Anderson was on sabbatical at Microsoft Research from fall 2001 to summer 2002. The project was brought back to the University of Washington in fall 2002 and a team of Computer Science students under Anderson’s guidance has continued development at UW since that time. In summer 2003, the student interaction component of Classroom Presenter was added. Classroom Presenter version 2.0 (released August 2005) was developed by the team at UW and relied upon the Microsoft ConferenceXP research platform for its networking layer. Classroom Presenter 3 (released January 2008) represents a complete re-write of the system. Among other things, the networking model was changed from multicast to TCP/IP, increasing reliability and removing the dependence on ConferenceXP.

3.2 Widespread usage

Since its initial deployment in spring 2002, Classroom Presenter has been used extensively in engineering classrooms at a wide variety of institutions (we know of deployments on every continent except Antarctica). Although originally designed for use in university level classrooms we are aware of use in K-12 classrooms as well. Courses where the system has been used range in size (lectures of hundreds of students to small seminars and recitation sections), level (introductory to graduate level), and topic (electrical engineering and computer science to mathematics and environmental science). Classroom Presenter 3 has been downloaded over 7,000 times from our web site since January 2008.

At the University of Washington, Classroom Presenter has been used for distance education in more than 20 graduate level computer science courses including a recent deployment with real-time interaction between students at three separate locations - UW, Microsoft, and Lahore University of Management Sciences in Lahore, Pakistan [17]. In fall 2006, lectures recorded at UW using Classroom Presenter were used for a tutored video instruction offering of an undergraduate algorithms course at Beihang University in Beijing, China [1, 4].

Source code for the system is freely available [20] and several instructors have extended the system to suit their own needs. Examples include the Ubiquitous Presenter project at UCSD [12] and Classroom Learning Partner [9] at M.I.T, as well as a paper interface for Classroom Presenter [13]. We estimate usage of Classroom Presenter by thousands of instructors worldwide and impact on tens of thousands of engineering students.

4 Objectives

Classroom Presenter, when used as a presentation system aims to:

- enable the flexible delivery of lecture content, and
- increase student engagement and understanding of material.

In addition, the use of Classroom Presenter with student devices has the objectives of:

- lowering barriers to contributing so that more students feel comfortable participating in class,
- making instructors more aware of their students’ level of understanding, and
- allowing instructors to provide feedback to students by integrating student work into classroom discussions.

5 Using Classroom Presenter

There are two main usage scenarios for Classroom Presenter: 1) instructor presentation and 2) interaction with student devices. Classroom Presenter can also be used to support distance learning in either scenario.

5.1 Presentation with Classroom Presenter

When used purely as a presentation tool, Classroom Presenter allows the instructor to bring greater flexibility to their lectures by allowing them to ink on their slides. It also allows the instructor to embed “instructor notes” in their slide deck – text and objects that appear on the instructor’s machine, but not the public display. This can be very useful for reminding the instructor of how to complete a complex diagram using ink, or of the answer to an active learning exercise, taking some of the risk out of this more dynamic lecture style.
Any PowerPoint presentation can be loaded directly into Classroom Presenter 3 with no additional processing. However, if instructors wish to take advantage of the instructor note feature they can download a PowerPoint plugin that lets them add instructor notes in PowerPoint itself. In addition to PowerPoint presentations, images exported from LaTeX files can also be converted into “.cp3” format (Classroom Presenter 3 format) using DeckBuilder, a companion program included with the Classroom Presenter installation.

To take advantage of instructor inking capabilities, the instructor’s machine should be a Tablet PC running Windows XP or Vista. The instructor has two options for projecting. In the first scenario, he can connect his machine directly to the projector, and enable second-monitor output – the Public Display view will be projected. In the second scenario, he can have a second machine (not necessarily a Tablet) join the presentation as a Public Display machine, and connect that machine to the projector. The second option allows the instructor to lecture from anywhere in the room, untethered to the projector.

Figure 2: Instructor view. The instructor sees the filmstrip, controls, and instructor notes on their machine, but none of this is shown on the Public Display view that is projected.

The instructor’s toolbar (shown above in Figure 2) includes several groups of buttons corresponding to different features available in Classroom Presenter. The first group allows the instructor to change pen color, including a button that allows them to choose a custom color from a full palette. The second group includes all of the different pen type choices – normal pen, highlighter, eraser, and text input. Text input is new in Classroom Presenter 3, and allows the instructor to include students who have normal laptops, but not Tablets. The third group consists of slide editing actions, and includes “Erase Slide,” which removes all ink from the slide, “Slide Minimize,” which adds extra white space around the outside of the slide for inking (as shown in Figure 2), and “Undo” and “Redo” actions. Next, the instructor has three buttons that control their interaction with students who are connected to them through Presenter. The first allows them to choose whether to accept student submissions. The second begins a “quick poll,” allowing the instructor to ask a multiple-choice question. Starting a quick poll makes a set of multiple-choice buttons appear on the students’ view, and allows the instructor to receive a histogram of students’ votes, which can then be displayed to the class”.

The third button controls whether or not students can see the filmstrip view of the instructor’s slide deck and navigate freely among slides on their devices. Finally, there are three navigation buttons: one that takes the instructor to a blank “whiteboard” deck and two that allow movement forward and backwards within the current slide deck.

\[\text{Figure 2: Instructor view. The instructor sees the filmstrip, controls, and instructor notes on their machine, but none of this is shown on the Public Display view that is projected.}\]

A beta release of quick poll for Classroom Presenter 3 has been included with our Premier 2008 submission.
5.2 Interaction and feedback with Classroom Presenter

In the case where students have devices, they can connect to the instructor and receive the instructor’s ink and slide transitions in real time. Students can also ink on their copy of the instructor’s slides and submit their work to the instructor to view and display to the class as described in Section 2. With the addition of the text input feature in Classroom Presenter 3, students with normal laptops or desktop machines (not Tablets) can also use Classroom Presenter to participate. Students need to be on the same network as the instructor, which can be accomplished by having everyone connect to the Internet, creating an ad hoc network, or using a stand-alone wired or wireless router.

5.3 Distance learning

Both of the scenarios described above can be used to support distance learning. If the instructor is connected to the Internet, a remote Public Display machine also on the Internet can connect to the instructor and a projector, showing the instructor’s inking and slides in real time; if students also have devices, they can similarly connect to the instructor over the internet and receive ink and submit their work from anywhere in the world [17].

6 Examples of use

Here we show a few examples of how the system has been used in classes. Figure 2 shows a typical example of instructor inking during presentation. Several more examples of course materials used with Classroom Presenter for instructor inking can be found in the materials described below in Section 6.2.

6.1 Classroom Activities

In our experience, instructors who use Classroom Presenter for interaction with student devices have very clear educational goals for the activities that they design. These goals cut across engineering disciplines, and are quite diverse. It is useful to identify some of these goals in order to give a flavor of the kinds of activities that instructors design, as well as to provide a framework for thinking about activities that a new instructor might design. Several sample activities can be seen below in Figure 3.

We have identified a number of these common goals [15, 3] – here we will discuss just a few.

- **Pedagogical Point:** Often, an activity is designed to lead students toward a particular point of knowledge, as seen below in Figure 3a. This may require eliciting and correcting a commonly held misconception, or it may mean leading the students to an “A-ha” moment, where each individual has a valuable revelation.

- **Reinforcement:** Immediately after introducing a new topic, the instructor may wish to have students apply the new concept in a concrete setting, as seen in Figure 3b. This can help get students thinking about nuances of the concept that they are unlikely to consider in the abstract.

- **Classroom Assessment:** It has been widely recognized that it is important for an instructor to have a good idea of how well students understand the concepts under discussion, (see Figure 3c).

- **Discussion Artifact:** It is often more compelling for an instructor to explain a point by using a student-generated example than it is to lecture on that point from prepared slides, (see Figure 3d). The idea is that student artifacts have impact when displayed in lecture, since the students know that the solution was created by one of them, and they have each tried to solve the problem themselves.
Figure 3: Sample Activities
(a) This Pedagogical Point activity allowed students to discover that some codes could be ambiguous, before the instructor had introduced the concept of ambiguity. (b) A Reinforcement activity that asked students to apply the concept of a system to a tree, identifying the inputs and outputs, two of the key components of a system. (c) This Classroom Assessment activity had students step through an algorithm to demonstrate whether they understood how it worked. (d) In this Discussion Artifact activity, students were asked to form an imaginary software team by choosing from a set of candidates and obeying a number of constraints.

6.2 Example Deployments and Course Materials

Below are links to a few examples of courses where Classroom Presenter has been used for both presentation and for interaction with student devices, including usage for distance learning, and tutored video instruction. A variety of materials are included for each of these courses: original lecture slides (in PowerPoint and pdf formats), slides annotated with instructor ink, student submitted slides, and in some cases video archives integrated with instructor slides and ink and display of student responses. We list these examples because they illustrate a variety of usage patterns, are well-documented, and show how slides annotated using Classroom Presenter were made available as a resource to students in the course while the course was in progress. (Ink-annotated slide decks can be easily exported to a web page from within Classroom Presenter.) A list of links to several other courses with on-line materials available is given in the Appendix.

1. Presentation in an undergraduate course:

   CSE 321 Discrete Structures (Winter 2008)

2. Presentation with student interaction in an upper level undergraduate course:

   CSE 421 Introduction to Algorithms (Fall 2005)
   Lecture slides with ink and student submitted slides (See “Slides with Ink” and “Activity Summary”): [http://www.cs.washington.edu/education/courses/cse421/05au/slides.html](http://www.cs.washington.edu/education/courses/cse421/05au/slides.html)
3. **Presentation** and with **student interaction** in a graduate level **distance learning** course with real-time interaction between students at UW, Microsoft, and Lahore University of Management Sciences in Lahore, Pakistan [12]. All lectures were videotaped and archived.

CSEP 590b Computing for the Developing World (Spring 2008)
Lecture slides with ink and student submitted slides (See “Slides with Ink” and “Student Submissions”):
Video Archives: [http://www.cs.washington.edu/education/courses/csep590b/08sp/lectures/](http://www.cs.washington.edu/education/courses/csep590b/08sp/lectures/)

4. **Presentation** and with **student interaction** in an upper level undergraduate course. Lectures were videotaped and archived and used for **tutored video instruction** [1, 4] in conjunction with Beihang University, in Beijing, China.

CSE 421 Introduction to Algorithms (Fall 2006)
Lecture slides with ink, lecture summary, and student submitted slides (See “Slides with Ink”, “Lecture Summary” and “Activity Summary”):

7 **Assessment**

Since its first use in engineering classrooms in spring 2002, we have studied the use of Classroom Presenter extensively, both when used solely as a presentation system and when used with student devices, through classroom observation, interviews, logs of activity on instructor machines, ink-annotated slides, and surveys. Here we present a few results from our surveys.

7.1 **Classroom Presenter as a presentation system**

7.1.1 **Instructor Surveys**

Throughout the development and deployment of Classroom Presenter, we have constantly sought feedback from instructors. Instructor input has been critical in evaluating the user experience and helping to design the next version of our software. In formal surveys, 9 out of 11 instructors rated the filmstrip and the whiteboard as critical features. Other features often mentioned as favorites include the ability to shrink slides to provide space for writing in context, and to add “instructor notes” to slides that are only visible to the instructor. Inking on slides has been widely used: we observed many classes where between 50 and 90 percent of the slides were inked. Overall, instructor reaction to the system has been very positive; typical instructor comments include: "It works great. It didn't take any adaptation. I just talked/discussed and when I needed an example, I just wrote. As easy as using the board,” and “Being able to diagram and spontaneously work examples, instead of having to use a pre-scripted PowerPoint slide deck felt like teaching a real class.”

7.1.2 **Student Surveys**

Overall students and instructors have responded very positively to the use of Classroom Presenter as a presentation system. Figure 4 below shows cumulative responses from 25 engineering courses taught by 15 different instructors at three different universities. Class sizes ranged from 7 to 181 students with an average size of 54 students. In these courses, 57% of students felt that use of Presenter **increased their attention to lecture** (n=572), 59% felt that Presenter had a **positive impact on their understanding** of the material (n=572) and 72% of students would **encourage other faculty to use the system** (n=541).
7.2 Classroom Presenter with student devices

Reaction in courses where Classroom Presenter was used with student devices has also been incredibly positive. Here we present aggregated student survey responses from four courses (122 students). Overall, 93% of students (114 out of 122) indicated that use of student devices had a “slightly positive” or “very positive” effect on their learning experience. 85% (104 out of 122) students indicated that they were “slightly” or “much more engaged” in the lectures where the student devices were used compared to those when the system was used only for presentation. 73% of students said that use of student devices made them more likely to work on a problem posed by the instructor than if the same problem had been posed without the system. More results can be found in [15].

Here are a few representative comments from student surveys (additional student comments can be found in the Appendix and in [15]):

“The best thing about this system is it encourages the students to actually work on the problem. Often times, we are asked to try some problems with people around us (not using tablets) and most of the time I don’t participate. Knowing that my solution will appear on screen but will also remain anonymous encourages me to participate but at the same time reduces the worry of getting it wrong.”

“It keeps me awake! And it also gives better explanation as visual perception is better for most people.”

“More engaging. I felt like I learned more during those sessions.”

“More enjoyable. Interactivity keeps me awake and engaged.”

“I felt like I had more hands on experience and better prepared for homework”

“Lectures were much more fun and interactive with it. I learned lots more, remembered more, and always looked forward to doing the activities.”

“Classroom Presenter was really effective in bringing students from remote sites together. I really hope it is made a standard for every PMP course.”
8 Summary of how Classroom Presenter addresses NEEDS Criteria

8.1 Instructional Design

**Learning Objectives are supported:** Classroom Presenter was designed to help instructors achieve whatever learning goals they deem appropriate for their particular classroom. For example, many instructors have taken advantage of the flexible delivery of lecture content to address the goal of keeping students engaged and active – by asking them to help solve a problem together with the instructor in real time, rather than viewing pre-scripted slides of the solution. When used with student devices, Classroom Presenter provides an obvious mechanism for allowing the instructor to measure student learning, by posing problems as activities, and for students to get feedback on their own learning – by viewing and discussing student solutions. As discussed in Section 6.1, we have been particularly impressed at the variety of objectives instructors have been successful at achieving beyond pure assessment. We have seen instructors create activities for the purposes of collecting a wide range of opinions, allowing students to explore a problem instance, reinforcing a concept, or generating artifacts for class discussion. Instructors have also found that the very act of designing student activities has helped them become more aware of what their objectives are for a particular class.

**Interactivity between students and instructor is encouraged:** Classroom Presenter promotes interaction in the classroom in several ways. When used as a presentation system, the instructor is better able to react to student input to modify the presentation accordingly. When used with students devices, students are encouraged to interact with their peers while solving problems. The instructor receives student responses and displays them to the class – reacting to student input in the aggregate by adjusting the presentation and on a personal level by focusing discussion on individual student responses displayed to the class.

**Cognition/Conceptual Change is promoted:** As discussed in Section 7, students report that the use of Classroom Presenter has positive effects on their learning experience, both when used as a presentation device and when interacting with student devices. Students also report that they are more likely to do activities (and thus reap the educational benefits of participation) when they are posed through the system than if the same activity were suggested on paper. The display and discussion of student responses provides immediate feedback to students, allowing them to gauge their own level of understanding of material. Researchers at other institutions have investigated learning outcomes in several courses in more detail and have found that Classroom Presenter improves learning [10, 11].

**Existing content is leveraged and well structured:** The use of slides as the basis for presentations and activities in Classroom Presenter allows instructors to leverage content they have already invested large amounts of time preparing. While creating activities and crafting presentations that are more dynamic requires modification, this can be done over time at the instructor’s own pace. Having activities be based on a slide in the instructor’s presentation integrates student activities directly into the flow of lecture, making it clear to students how an activity relates to lecture content, and easy for them to browse related lecture slides while responding to activities.

**Multimedia is used effectively:** One of the advantages of using prepared slides displayed with a computer is the ability to use high quality examples. Indeed many of our instructors use photographs and complex PowerPoint diagrams in their lectures and as the basis for activities. Annotating slides with digital ink in Classroom Presenter allows instructors to draw attention to relevant portions of a slide, extend examples based on student input, or work through a problem. This inking is high quality (pressure sensitive), and occurs in real time (students see an ink stroke as it is being drawn, not just once it is completed). Classroom Presenter’s inking controls make it easy for instructors and students to take advantage of multiple ink colors and pen tips, including customizable colors. Instructor or student slides that have been annotated with ink can be exported as high quality images and posted on a web page or sent to a printer easily from within Classroom Presenter.

**The system has been widely used and adapted:** Classroom Presenter has been used widely at a variety of institutions, in a range of engineering fields, and in multiple settings. This widespread use is due in part to being based on a presentation medium (computer projected slides) that is already common with many instructors. In addition, adaptability is enhanced by supporting an incredibly wide range of student activities: anything that can be specified with a slide (including a slide annotated with ink) and answered with ink or text.
Although originally designed for use at the university level, Classroom Presenter has been used by instructors at K-12 institutions as well. The system has been used in conjunction with tutored video instruction [1, 4] and in many distance learning efforts [16] including the use of student submissions [17]. In addition, researchers at several institutions have extended Classroom Presenter [9, 12, 13] to address their own needs. User support is provided in the form of tool tips, a help menu, web resources [18], and a user mailing list [19]. Many user options are customizable (pen colors, saving options, filmstrip orientation).

8.2 Software Design

Engagement of a diversity of learners: As discussed in Section 7, students consistently report that use of Classroom Presenter either as a presentation system or in conjunction with student devices increases their attention and engagement in lecture. Both doing activities and viewing displayed student responses increases student interest in lecture material. In surveys, students report that they value the anonymity of the system. Shyer students can respond to activities without fear of embarrassment. Students repeatedly say on surveys and course evaluations that they wish other instructors would use the system.

The system interface is easy to use: In our experience, most students and instructors are able to use Classroom Presenter with little guidance or advance instruction. Students quickly figure out how to annotate slides with ink and text and to submit their responses to the instructor. Students and instructors are able to make use of the filmstrip for navigation within a presentation and tabs to switch between slide decks. Common actions are accessible both via buttons on the toolbar and menu options. Undo and redo buttons are available to correct accidental actions.

Technical Reliability: Since its release in January 2008, Classroom Presenter 3 has been downloaded over 7,000 times from our web site. This latest version has benefited from years of feedback from users from a wide variety of institutions and engineering disciplines. We constantly receive and react to feedback from users deploying our system on different combinations of student and instructor devices, projectors, and networking configurations.

While we consider version 3 of Classroom Presenter to be robust and functional, as a complete re-write of the system there are some newer features that have not yet been thoroughly tested. In particular, the version of Classroom Presenter submitted to NEEDS includes a beta release of the quick polling feature (a feature from version 2.0 that many instructors requested be incorporated into version 3) that has not yet been released publicly. Although we have tested this version ourselves, it has not yet been subjected to the rigors of widespread deployment in real classrooms that the rest of Classroom Presenter 3 has benefitted from.

9 Summary

Classroom Presenter is a tool that was created to serve the needs of a wide spectrum of engineering educators. Not only does the system enable practices that good educators have long sought to pursue in the classroom (dynamic presentation, assess student understanding, provide feedback), but use of the features provided by Classroom Presenter in fact encourage these good practices in all instructors. Its broad usage is evidence of both its robustness and usability as a piece of software and its ability to improve the engineering classroom.

10 Acknowledgements

We greatly appreciate support from Microsoft Research External Research and Programs, Hewlett-Packard, and the National Science Foundation, which has made this work possible.
## Appendix

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A. References

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17. CSEP 590b Lecture Archives http://www.cs.washington.edu/education/courses/csep590b/08sp/lectures/
18. Classroom Presenter 3 Getting Started Guide  
B. Letters of Reference

We have included letters in support of Classroom Presenter from the following people:

Luke McDowell, Assistant Professor of Computer Science, United States Naval Academy

Kimberle Koile, PhD, Research Scientist, MIT Center for Educational Computing Initiatives, Lecturer, MIT Electrical Engineering and Computer Science Department

James Fridley, Professor of Ecological Engineering, Adjunct Professor of Mechanical Engineering
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Jim Vanides, Program Manager – Global Higher Education Grants, Hewlett-Packard

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July 7, 2008

Dear Premier Courseware Award Committee:

This letter is written to express my very strong support for Classroom Presenter as a candidate for the 2008 Premier Award. I have found Classroom Presenter to be extremely effective for teaching, and my student have been likewise very enthusiastic about it.

I have been using Classroom Presenter (CP) since 2003 and have used it in a range of courses from introductory lecture-style courses to more advanced discussion-focused courses. For most of my courses, it is my dominant tool and I use it for essentially every class session.

While I have used CP in a number of ways, I most often employ it in the following way: I use CP running on a Tablet PC, with the slides projected onto a screen for the students to see. The students do not have laptops or other devices, but I provide them with handouts of the slides. The projected slides and the handouts, however, are intentionally incomplete. As class progresses, I fill in (often with student input) the slides with additional details, pictures, and examples, which students add to their handouts. Thus, students have significant scaffolding for their notes, but are encouraged to remain active. More significantly, because the “final answer” (to the extent there is “one answer”) is not initially projected, class discussion is heightened and it easy to truly incorporate student feedback as we consider a particular problem.

This style of class is not unique nor is CP the only way to accomplish it. However, there are many features of CP that help to make it particularly effective, in particular:

- Compared to using a whiteboard or chalkboard, CP makes it easy to integrate my writing with existing pictures and text, easy to navigate among different slides, and possible to record what is created. Moreover, I can easily face the class instead of the board!
- Compared to using PowerPoint or another tool not specifically designed for such teaching, CP provides great controls for easily changing color, providing more space for extra writing (I love the “slide shrink” feature), and navigating between slides. In addition, CP retains my writing when I change slides. Moreover, I have always used CP in conjunction with “instructor notes,” which are additional information that is visible on my tablet but not projected to the students. These notes remind me of key points that I want to present and provide answers to exercises so that I can easily check to see if student-provided answers are in fact correct, even if I have occupied helping students while the exercise was in progress.

CP has been a tremendous help to my teaching. I regularly poll my students for comments, and invariably 95%+ of them indicate that they prefer this approach to either straight whiteboard or PowerPoint use. They have also provided many positive comments about (the Tablet PC based) CP, including:

- “A+ -- innovative tablet PC presentation was very effective.” (Fall 2005)
- (regarding course strengths) “Writing pad (amazing learning tool!”) (Fall 2006)
- “Best method I have seen at the academy” (Fall 2007)

I am very thankful to have CP as a tool, and have sought to promote its broader use. As a result, at least seven instructors from my small department have used the system in some way during class, and two have adopted it as their primary method for at least one course that I was not involved in. I expect its use only to grow, and think that the Premier Award would be very appropriate for CP and a way to expose more educators to its benefits.

Sincerely,

Luke McDowell
Letter of Reference for Classroom Presenter

It is a pleasure to write in support of Classroom Presenter for the 2008 Premier Award for Excellence in Engineering Education Courseware. For the past several years, Classroom Presenter has been an integral part of both my teaching and my research. I have used Classroom Presenter quite successfully to teach MIT's introductory computer science course. I also have used it in my research: (1) to test the hypothesis that Tablet-PC-based classroom interaction systems such as Classroom Presenter improve student learning, especially among students who might otherwise be left behind, and (2) to investigate the feasibility of using Classroom Presenter in large classes, extending the system with ink interpretation and aggregation modules so that an instructor would not be overwhelmed with dozens, even hundreds, of student answers.

To test the student learning hypothesis, I used Classroom Presenter in MIT's introductory computer science class over a two-year period. In three of four terms, I ran rigorously controlled studies in which one of my two class sections used Classroom Presenter or my group's version, called Classroom Learning Partner; and a second class section used paper handouts and blackboards. I am pleased to report that students in the class using Classroom Presenter or Classroom Learning Partner showed statistically significant improvements in learning [1, 2, 3].

To investigate the feasibility of bringing the benefits of Classroom Presenter to large classes, my group developed Classroom Learning Partner by adding to Classroom Presenter a central repository, and ink interpretation and aggregation modules. The idea has been to store student ink submissions in the repository, interpret the ink submissions, then aggregate the interpretations into equivalence classes. In this way, the system can present an instructor with a histogram representing students' answers, in much the same way that "clicker" technology does. A prototype of the system was successful for a limited but useful set of student answer types, e.g., number, string, sequence [2]. Work continues on extending the system to include other types.

In summary, Classroom Presenter has been indispensable to my teaching and my educational technology research. It is well-deserving of recognition as courseware that will dramatically improve both teaching and learning.

Kimberle Koile, PhD
Research Scientist, MIT Center for Educational Computing Initiatives
Lecturer, MIT Electrical Engineering and Computer Science Department


To: Evaluation Committee

Re: 2008 Premier Award Competition: Classroom Presenter™

From: James L. Fridley and Thomas M. Hinckley, Professors, College of Forest Resources

We strongly support the nomination of Classroom Presenter™, an instructional methodology developed by Professor Richard Anderson and his students, for a 2008 Premier Award. We will document the specific nature of the educational innovation that Classroom Presenter™ and tablet PCs have brought to courses outside of engineering, specifically to a set of courses that we teach in the environmental sciences. In addition and based upon our personal experiences, we will discuss the potential breadth of adoption this educational technology and, therefore, its potential impact on education in the applied and basic sciences.

Reform efforts in undergraduate education in the sciences have a strong, but relatively recent history that recommends more effectively engaging students in their learning through active- or experiential-learning. Based in part on these recommendations, the College of Forest Resources adopted in 2003 a new, integrative curriculum for its Junior year corner-stone sequence, that features the physical, biological, social and economic principles governing the stewardship and restoration of a wide range of biological systems, most of which are plant based. The new curriculum aims to prepare students for diverse requirements in the field of Environmental Science and Resource Management (ESRM): critical thinking and problem solving skills, and the ability to work with others being paramount among these.

The instructors sought to adopt an interactive, hands-on teaching style in these courses, using field trips and in-class activities. The decision was to utilize an interdisciplinary, problem-solving focus and to foster active- and experiential-based learning as the pedagogical foundation. We (and our colleagues) tried a range of different interactive techniques with varied success, but in most cases they either did not adequately engage the majority of the class or they were technically cumbersome or they took too long to introduce and complete during the class session. As instructors, we were frustrated in our ability to adequately meet our pedagogical goals. Therefore, we initially sought out Professor John Bransford and others in the College of Education at the University of Washington. They immediately recommended that we talk with Professor Richard Anderson. These conversations led to a successful NSF grant for which Richard was the PI and we were the coPIs. Through the grant, we first introduced the use of Classroom Presenter™ and Tablet PCs into ESRM courses beginning in Winter 2006.

By Autumn 2006, we had fully embraced the Classroom Presenter™ technology and taught ESRM 303 using this technology. Richard and two of his graduate students provided curricular, instructional and

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technical support as we fully engaged this new technology. The 26 students in the class worked in teams of two during each lecture when responding to all Classroom Presenter™ exercises. At the end of the quarter, a traditional course evaluation form was completed as well as a form to specifically evaluate the use of this technology via numerical and free-response questions. Student responses to the use of Classroom Presenter™ were overwhelmingly positive. When asked what impact the system had on their learning experience, the average on a 1-5 scale was 4.32. When asked what impact the system had on their level of engagement, the average response was also 4.32. When asked how the lectures with the student participation system compared with lectures without the system some student comments were: “Much better. This is one reason why this has been the best core series class.” “I learned from my peers and heard what other ideas were out there besides mine or the professor’s.” “…I felt more interested and willing to learn because it involved more class discussion and individual involvement.” Given the novelty of this technology and, and more importantly, the instructors’ relative inexperience, we were greatly surprised (and overwhelmingly pleased) how positive the reaction was.

We believe the outcome speaks to the extraordinary utility and value of this technology. In addition using it in ESRM 303, we are using it in ESRM 301 (Fridley co-taught with Reichard and Wolf, Winter 2007) and CFR 521 C (a graduate student discussion course, Hinckley). Professor Anderson and his two students continue to assist the two of us in our use of this technology and have been very willing to let us try new uses and venues for use. In our combined 68 years of teaching where we have likely taught several dozen different courses across a wide range of disciplines including biology, engineering, environmental sciences, forestry, and math, we easily visualize the effective use of Classroom Presenter™ in these previous experiences. Based upon our positive experiences with this technology, we have made presentations at local to national meetings.

This has been an incredibly positive experience for us – we have met pedagogical goals, we have improved our evaluations, we have greatly improved our instruction (because designing classroom exercises using Classroom Presenter™ forces greater attention to learning objectives, content, organization and delivery), and, most importantly, we have improved student participation and learning. Without Classroom Presenter™ (and, therefore, the work of Professor Richard Anderson and his students) none of this would have been possible. If we may be of further assistance, please do not hesitate to contact us (206.543.1588, 206- 543-6993 or hinckley@u.washington.edu, fridley@u.washington.edu).

Sincerely yours,

Thomas M. Hinckley
Professor of Tree Physiology
Adjunct Professor of Biology

James Fridley
Professor of Ecological Engineering
Adjunct Professor of Mechanical Engineering

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2 For example, in our previous attempts to use a range of different active-learning approaches, our scores for ESRM ranged from a low of 3.3 to a high of 4.2.


Memorandum

To: National Engineering Education Delivery System

From: Jim Vanides, Program Manager – Global Higher Education Grants
Hewlett-Packard  www.hp.com/go/hpteach-hied

Subject: 2008 Premier Award – Classroom Presenter

Date: May 16, 2008

Dear Premier Award Reviewers,

It is with great pleasure that we provide this letter of support to accompany the courseware submission from Dr. Richard Anderson. The courseware for consideration, Classroom Presenter, is considered by many to be the best freely available software system for supporting exemplary instruction and classroom interaction.

Dr. Anderson was the Principal Investigator for HP mobility grants to the University of Washington awarded in 2003 and 2004, where he created Classroom Presenter and pioneered the use of tablet pcs for in class real-time graphical response. As a result of his continued efforts in enhancing Classroom Presenter, promoting interactive pedagogy, and his willingness to freely share the software for non-commercial use, many HP Technology for Teaching grant recipients from around the world are using Classroom Presenter to enhance teaching and learning. We frequently receive reports from faculty who exclaim that Classroom Presenter used in conjunction with tablet pcs has transformed their classrooms.

We applaud Dr. Anderson for his pioneering work in changing the very nature of faculty-student in-class interaction. Classroom Presenter is providing faculty with a simple yet powerful tool to improve presentations, enable better student note-taking, and enable anonymous real-time feedback that reveals student misconceptions – the ideal formative assessment tool for the classroom. That Classroom Presenter has now been used in universities and colleges around the world, is a testimony to the contribution Dr. Anderson has made to improving learning and teaching in higher education.

For these reasons, we offer our highest recommendation to the Premier Award review team.

Best regards,

Jim Vanides
Dear Members of the FIE Premier Award Committee:

I am writing to enthusiastically recommend ClassroomPresenter for your prestigious award. I have used the software in 3 of my classes over the past couple of years and it has dramatically affected my effectiveness while radically improving my awareness of how well students are grasping the material.

ClassroomPresenter is a fabulous teaching tool that I have found to be the single best teaching innovation in my 20 years of being in front of a classroom. I teach hardware design classes that have a large diagram generation and analysis component. I have to pre-prepare many examples as they have many details that are difficult to do in real-time during lecture. Classroom Presenter allows an instructor to add ink to lecture slides in real-time making lectures more interactive and mitigates many of the numbing effects of long PowerPoint presentations. The really interesting feature of Classroom Presenter is that the instructor can also send slides to the students and receive the work they do on their own tablets to display, analyze, and critique in front of the entire class.

By giving me the ability to quickly annotate with ink and add to the diagrams incrementally, ClassroomPresenter gives me the best of both worlds: prepared slides and whiteboard dynamics. More importantly, ClassroomPresenter allows me to give work to the students to do in class and collect their responses. It is important to note that the work is submitted anonymously so that neither I nor the students in the class know who is the author – this encourages many students to participate that may have shied away from active participation in a more traditional setting. I can then display these answers to the class without embarrassing the student(s) that generated the work and discuss the solution – showing its strengths and weaknesses, highlighting ambiguities and alternative approaches. Often, the students do identify themselves, but it is their choice and this is important in making them comfortable in putting their work in front of the class. I have found that this feedback goes a long way in quickly finding areas where students are having difficulties and has been very effective in improving student assignments and exams as the students have a chance to directly observe how I interpret their work and what makes a diagram more or less confusing.

It is taxing as an instructor to provide interpretation on-the-fly, however, it is invaluable in providing the students with real-time feedback (rather than a two week cycle of homework turn-in and grading where they never have time to go back and review solutions). I have now used ClassroomPresenter in three of my classes and it has made a dramatic difference each time. It keeps the students engaged by making me stop talking and re-engages them with the material. In addition, I find it beneficial to have pairs or trios of students share the tablets and work together on a problem – thus, also getting to know each other a bit better and learning from each other’s thought processes.

Most importantly, it gets them the feedback they need, and it gets me information about how well they are understanding my lectures while I still have time to correct any misconceptions, provide alternate explanations, and/or expand on the material. It has been truly revolutionary and I’ve seen measurable improvement in the students’ understanding of the material. This is an outstanding contribution to engineering education. It is particularly innovative and I expect to have lasting impact on both the students and our curriculum as well as forever affecting my teaching methods.

Richard Anderson has done an exemplary job of packaging ClassroomPresenter for others to use. He has used his and his students resources to facilitate the introduction of the tool into many classes both at UW and elsewhere. He has published the work in highly visible venues and made the software particularly easy to install. These activities have shown exemplary scholarship and a high-level commitment to students. Ensuring that the tool is used in a
variety of engineering courses from computer science and engineering to forestry. He has demonstrated a commitment to understanding how to deliver engineering education. The tool is particularly well-tailored to the pedagogical needs of engineering programs. I am also happy to see that Richard is porting the tool to the OLPC and making it available to an entire new category of students. ClassroomPresenter is particularly well-suited to the OLPC model.

In summary, ClassroomPresenter has made a big difference in my teaching by making my lectures more engaging and providing valuable feedback to both me and my students. The learning outcomes have measurably improved, and I am happy to say, so I have my teaching evaluations. I believe ClassroomPresenter is an ideal candidate for your Premier award.

Please do not hesitate to contact me by phone or e-mail if I can be of further assistance.

Sincerely,

Gaetano Borriello
Jerre D. Noe Professor of CSE
This is a statement of reference for Classroom Presenter 3's nomination for the FIE Premiere award for courseware. Classroom Presenter is an amazing piece of software which, in my experience, has significantly increased the appeal, effectiveness, and interactivity of my teaching. It receives my greatest praise as an educational technology which changes the ball game for interactive teaching.

First let me give a little background. I used Classroom Presenter to teach a data structures course in the Computer Science & Engineering department at the University of Washington. My own educational background is actually from physics and one of the main thrusts of physics education over the past decades has been the shift towards a highly interactive teaching style wherein the major conceptual difficulties which students encounter in physics are revealed to the instructor through various feedback mechanisms. For example, many large first year university courses in physics utilize "clickers" so that an instructor can gauge the students' grasp of the subject, and the students are forced to actively engage the material. These techniques, however, are brought to an entirely new level via the use of Classroom Presenter.

First of all, lectures with PowerPoint are notoriously difficult to give properly. I have seen many a lecture where slides are covered head to toe with prewritten text which leads directly to a speed reading of the material by the instructor. Classroom Presenter, however, is designed specifically for tablets, and has many features which make the slides prepared using it much more akin to blackboard presentation. For instance instead of creating a lot of writing on a slide, one can instead prepare notes which are readable from the instructor’s computer alone. This lends itself to a style where your lecture notes are on the slides, but you actually write them out as you go along. While this is possible using traditional PowerPoint, Classroom Presenter's abilities to position the notes easily and effectively really lends itself to this slower, and more thoughtful, teaching style.

Second, and more importantly, Classroom Presenter allows for an astounding amount of student-instructor interaction. The ability for students to write on a tablet and then beam it up to the instructor is an awesome capability. While one can get feedback from students via direct query, clickers, etc, Classroom Presenter forces students to put in writing what they are thinking. Thus instead of getting brief shots of how they are doing, you can ask a question and get detailed responses which allow for further probing, questioning, and feedback. The ability to then take what the students have sent you, and pick out the ones that show common conceptual difficulties is astounding. There is nothing better than finding that a student has sent you a classic misconception in their slides which you can use to illustrate the problem. Since all of this is anonymous, the students feel very comfortable beaming you their slides. Indeed I quickly learned using Classroom Presenter that both the students and I looked forward to the days where we made extensive use of this feature.

Finally, I think one should not overlook the fact that Classroom Presenter allows for students to be very creative. The amazing stylistic flourishes that the slides allow turn a monotonous exercise into one with a lot more pizzazz. I would compare this ability to the well known ability of humor to help support student-teacher interaction: it truly makes class more enjoyable for instructor and student.
In short, Classroom Presenter marks, for me, a major change in how I would like to teach a class. It is a communication tool which aids student-instructor dialogue like no tool I've encountered before. For this reason, I highly believe Classroom Presenter is deserving of the FIE Premiere award for courseware.

Sincerely,

Dave Bacon
Research Assistant Professor
Department of Computer Science and Engineering
Adjunct in the Department of Physics
University of Washington
C. Additional Student Comments

Here we present additional student comments from surveys in response to the question: “Generally, how did the lectures where the student participation system (Classroom Presenter) was used compare to the lectures when it was not used?” More comments can be found in [14].

“I liked student participation days better.”
“BOTH WERE GOOD BUT I LIKED THE TABLETS”
“Better. Gave me a reason to come”
“much better, paid more attention”
“More engaging & fun “
“The former lectures made me more attentive and I often felt like I understood more because there were questions to test what I just learned”
“More engaging. I felt like I learned more during those sessions.”
“More enjoyable. Interactivity keeps me awake and engaged.”
“They were more interactive; it was easier to stay focused and pay attention”
“It keeps me awake! And it also gives better explanation as visual perception is better for most people.”
“Good for review of concepts previously learned and practicing things just taught”
“Better, more hands-on”
“I felt like I had more hands on experience and better prepared for homework”
“Lectures were much more fun and interactive with it. I learned lots more, remembered more, and always looked forward to doing the activities.”
“More fun, helped to understand the material better”
“Learned data structure procedure slightly more. Was def. more engaged.”
“better understanding of the material when we compared answers”
“better understanding of concepts”
“The former lectures made me more attentive and I often felt like I understood more because there were questions to test what I just learned”
“I stayed awake in the 305 lectures with the tablets, and generally learned more.”
“more fun by a long shot, more educational through hands-on experience.”
“More exciting, more practice vs. learning”
“a lot more lively—I learned more, I was more involved and more awake”
“Much more interactive. I especially enjoyed the opportunity to work through the sample problems.”
“More fun, because of discussion w/other tablet-sharers, etc”
“explaining how trees rotate isn’t very effective... Seeing it like this, and trying with a partner is very nice”
D. Additional Materials

Please visit: http://classroompresenter.cs.washington.edu/premier2008/ to access the following materials:

- Classroom Presenter 3 software download for Premier 2008 submission
- Short video describing Classroom Presenter
- Sample PowerPoint Presentation to help new users get started with Classroom Presenter
- Additional Papers and Presentations
- Links to additional materials from courses using Classroom Presenter including:
  - CSE 326 Data Structures (Winter 2006), Instructor: Ruth Anderson
  - CSE 326 Data Structures (Winter 2007), Instructors: Ruth Anderson and Dave Bacon
  - CSE 403 Software Engineering (Summer 2006), Instructor: Valentin Razmov
  - CSE 457 Computer Graphics (Spring 2007), Instructor: Brian Curless
  - CSEP 505 Programming Languages (Autumn 2003), Instructor: Craig Chambers
  - CSEP 505 Programming Languages (Spring 2006), Instructor: Dan Grossman
  - CSEP 510 Human Computer Interaction (Winter 2004), Instructor: Richard Anderson
  - CSEP 544 Database Management Systems (Winter 2007), Instructor: Dan Suciu
  - CSEP 545 Transaction Processing for E-Commerce (Spring 2007), Instructor: Philip A. Bernstein
  - CSEP 548 Computer Architecture (Spring 2005), Instructor: Susan Eggers
  - CSEP 573 Applications of Artificial Intelligence (Winter 2003), Instructor: Henry Kautz
  - CSEP 590TU Information Technology & Public Policy (Autumn 2004), Instructor: Ed Lazowska
  - CSEP 590TU Practical Aspects of Modern Cryptography (Winter 2006), Instructor: Josh Benaloh
  - CSEP 590A History of Computing (Autumn 2006), Instructor: Ed Lazowska
  - CSEP 590B Computing for the Developing World (Spring 2008), Instructor: Richard Anderson