

PERC: A DEPARTMENTAL SOLUTION FOR WEB-ENHANCED COURSES

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ABSTRACT

Since the Fall of 1998, the department of Physics and Astronomy at Mississippi State University has been using and developing PERC (Providing Electronic Resources for Courses), a set of utilities that can be used to supplement regular courses with web content. PERC was developed to help infuse proven innovative and effective teaching practices into introductory courses. It was meant to affect both the in-class activities as well as the outside of class activities. Some of the examples envisioned were the Just-in-Time teaching method as well as the use of inquiry-based tutorials. To insure continuity, effort was made to ensure that the tools were easy to use by both students and faculty, and that they do not require an extra time investment from the faculty. For instance, PERC allowed faculty teaching several sections of the same course to seamlessly deliver the same content to all sections while maintaining student records separate. Furthermore, PERC's design allowed faculty teaching the same course to easily collaborate in developing assignment questions. Since then PERC has evolved into a department level course management utility. It is now used to provide homework, quizzes, grades, notes, message boards, as well as laboratory oversight.

We will use this paper to describe PERC, the modular approach used in developing it, as well results from feedback surveys.

KEYWORDS

Education, computer, course, management, physics, web, PERC, ITAL, WebCAI, WebQuiz

INTRODUCTION

The Mississippi State University physics department has been using Web content to enhance courses since 1995. Initially, most of the content was limited to mailing lists and static web pages of the syllabus, assignment lists, old tests, and homework solutions. During spring 1997, in a few classes, homework solutions were provided in an interactive-tutorial format using WebQuiz, a free Microsoft Windows based utility for generating interactive web-based tutorials (WebQuiz, 2003). Student reaction was overwhelmingly positive, and preliminary results on the effectiveness of using Web-enhanced teaching strategies on student learning were encouraging (Mzoughi, 1999). As a result, several faculty members have contemplated using online assignments. At that time, the only available class management systems (CMS) required steep learning curves and did not provide the flexibility we were looking for. We have decided to develop PERC, our own set of utilities (Mzoughi, 2000). In developing PERC, our goals were:

- To develop tools and content that can affect both the in-class activities as well as the outside of class activities
- The tools should include online assignment delivery mechanisms.
- The tools should be easy to use for both faculty and students.

Currently, there are many more CMS available. Some like PERC, are university grown, others are commercial (Landon 2002, ION 2003). Even though we suspect that many are now intuitive, full featured and easy to use, PERC still offers many advantages for our particular setting.

DESCRIPTION OF PERC

PERC is made up with three interfaces, the Student Interface, the Faculty Interface, and the newly added Laboratory Instructor Interface.

Student Interface

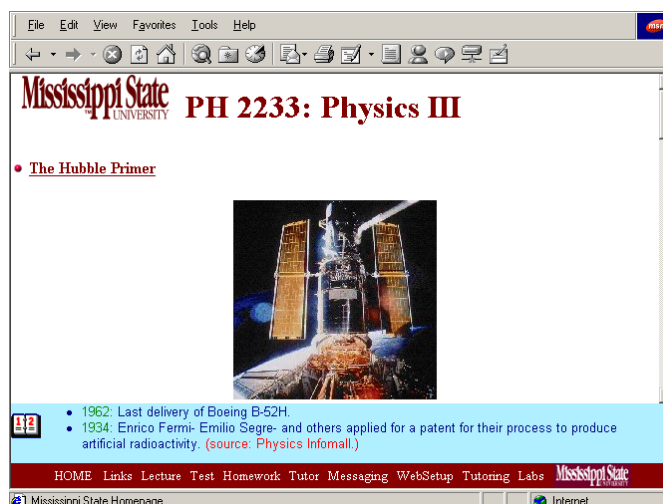


Figure 1. The template used by PERC for class web pages. The top frame includes all relevant classroom information, the middle frame includes a list of historical events, and the bottom frame includes the navigation menu

The use of PERC is insuring that every introductory physics course has a web page. These are generated at the beginning of every semester. Access to all these pages can be obtained at <http://physics.msstate.edu/>. At a minimum, a default page including the syllabus and links to relevant simulations and tutorials are provided. The content of the web page can then be modified by the professor teaching the course. A template of the web pages used is shown in Figure 1. The web page design follows an open access format. Students need to submit a password only when needed and only once during a session. The utilities that require authentication are the message board, online assignments, lecture notes, online tutorials, web-records, upload utilities, and grades. Some professors elect not to use these tools and just use PERC for posting homework and test solutions in Adobe Acrobat PDF format. Some still use PERC to provide practice with the WebQuiz utility. For courses requiring authentication, students are allowed to choose their own password by completing a form at the beginning of the semester. PERC allows Faculty to use their own design for the student interface; yet, most prefer to use the provided template.

Faculty Interface

The faculty interface of PERC provides access to a set of utilities that can be used to provide online content and to manage class information. Figure 2 shows an example interface. Faculty can use PERC to:

- Modify the content of the course web page.
- Generate password protected web pages.
- Author online assignments.
- Provide a course calendar.
- Monitor and contribute to the message board.
- Customize links to online simulations.
- Manage online grades and post grades.
- Collect and monitor Laboratory grades.

- Manage class and student information.
- Provide access to the available online tutorials.

Tools & Links

- HOME
- WebEdit
- Grade
- Assign
- Calendar
- MBoard
- Records
- Simul
- Setup
- Labs
- TAs
- Computers
- Department
- 2213-01
- 2213-02
- 2213-501
- Site Map
- Banner
- MSU

PERC Physics Education Research in Courseware

A collaboration between the Colleges of Engineering and Arts and Sciences.

Welcome to the PERC faculty page.

To use the utilities available through this page, you need to use the menu on the left of the page. A description of the function of the menu items is available in the following text.

- List of Links that You can Use with PERC

- WebEdit
 - CoursePage: Utility to help set-up the main WebPage
 - WebPage: Utility to help generate a standard webpage
 - SecurePage: Utility to help create a secured webpage
 - Edit SecurePage: Utility to help edit a secured webpage

Figure 2. The faculty interface for PERC. A menu at the left of the screen provides access to all utilities. The interface is user-specific

Additionally, PERC was used to provide some department functions. For instance, faculty can:

- view Sunshine fund disbursements and their own contributions to the fund.
- modify their password.
- post news items to the main department web page.
- add items to the historical events calendar.
- complete an on-line Vitae.
- add simulations to the department simulations database.

For faculty provided with administrative access, they can set up the start of semester course data and manage the overall faculty access to PERC.

Furthermore, faculty were provided with the ability to add their own utilities to the PERC interface. In the overall design of PERC utilities, effort was made to insure that most tools use a similar interface.

Course WebPage Utility

Use this link to modify the main WebPage elements

Use the following table to set up the items listed in the student page menu, their corresponding title on the body of the webpage, and the links associated with them. The links associated with each title can be edited by clicking on edit.

Note that you can add some of the items as links without including them in the menu. You can add new menu items at one of the three boxes provided at the bottom. However, you will not be able to add links to the item until you submit this page once and restart.

WebPage Body Title		Menu Title - Order
Important Links	<input checked="" type="checkbox"/> Edit	Links 1
Lecture Quizzes and Notes	<input checked="" type="checkbox"/> Edit	Lecture 2
Online Quizzes	<input checked="" type="checkbox"/> Edit	Quiz 3
	<input type="checkbox"/>	

Un-check this box if you don't want to include the Physics Calendar Frame.

Please note that the changes that you have made will not materialize until you press the "Update Webpage" button.

Update WebPage

Figure 3. Web page Authoring interface: simply completing text boxes generates all elements of the web page

Figure 3 illustrates the Web page Authoring interface for faculty who elect to use PERC's template. Faculty can also access their html folder through the local area network and can upload pages to the site through a separate PERC upload utility. This same interface is used for authoring the online syllabus for the course and for generating an online vitae.

Authoring Utility for Online Assignments

The authoring interface for online assignments is shown in Figure 4. Four question types are allowed: multiple-choice, randomized numerical, numerical, and open-ended. For multiple-choice questions, the number of possible answers is unlimited. The user can use html tags in the question and in the answers and can incorporate multimedia elements. Answers on the obtained online assignment appear in a different order for different students. Randomized numerical questions are quantitative questions where up to ten variables can be assigned pre-calculated random values. The user needs to provide the random values and their corresponding answers in the answer box. The obtained question randomly assigns different numbers for different students. Numerical questions are simple quantitative questions with one answer. Open-ended questions are questions that require manual grading.

Question

Scroll down for instructions.

Question Type: Chapter Information:
 Section #:

Question:

A rocket is launched at an angle of ****variable**** ° to the horizontal from an altitude of ****variable1**** m with a speed of ****variable2**** m/s. Use energy methods to find its speed when its altitude is ****variable3**** m. Answer in units of m/s.

Add random variables to "Randomized Numerical" questions:

Variable 1	Variable 2	Variable 3	Variable 4	Variable 5
Variable 6	Variable 7	Variable 8	Variable 9	Variable 10

Answers: (one entry per line, press the combination shift enter to go to next line.)

9.15;53.0;6;5;3.0
 10.23;52.0;7;6;3.5
 11.29;51.0;8;7;4.0
 12.34;50.0;9;8;4.5
 13.38;49.0;10;9;5.0

Answer: Tolerance:

Explanation: (detailed explanation in html or plain text.)

From the conservation of energy:

 $K_{i} + U_{i} = K_{f} + U_{f}$

 $m g h + m v_{0}^{2} / 2 = m g h / 2 + m v^{2} / 2$

 we obtain

Figure 4. Authoring interface for online assignments

Most importantly, PERC’s authoring interface uses a collaborative paradigm. Whenever a faculty authors a question for an online assignment, the question is automatically made available to all faculty members teaching the same course. When making an assignment, a faculty member can use a question she/he has authored, a question authored by another faculty member, or ‘clone’ i.e. a modified copy of a preexisting question. Users cannot modify or delete questions they have not authored; they can only use them or clone them. Figure 5 shows an example of the collaborative interface. When a user selects “edit” or “clone” a pop-up window appears with an interface identical the authoring interface shown in Figure 4.

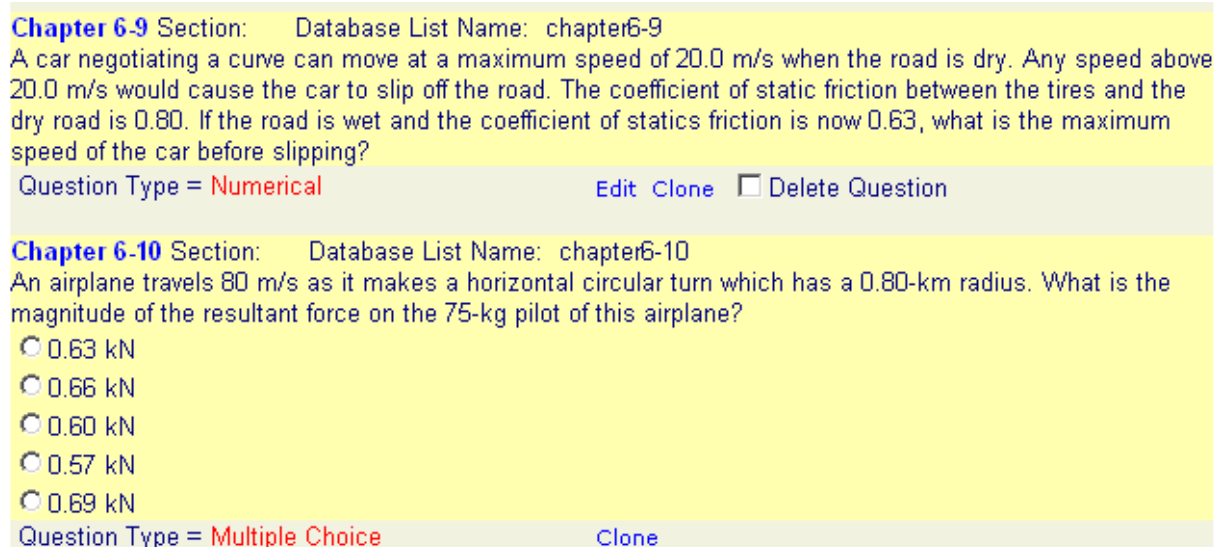


Figure 5. A view from the collaborative environment of the online assignment-authoring interface. The user can select to add the question, clone it, edit it or delete it. Edit and Delete are available only to the original author of the question

Finally, when providing an online assignment for their classes, users can easily select the format and details of the assignment. They can select the delivery mechanism (one question at a time or all questions at one time), the assignment category, the timeline, whether or not the assignment is timed, and the type and time of the feedback provided.

Grading Utility

Multiple choice, randomized numerical, and numerical questions are graded automatically. The user can easily fetch assignment grades at any time. The user is then provided with both a tabular and graphical summary of the grades. A text box below the graph provides tab-separated data that can be easily transferred to the user's spreadsheet. The faculty member can also elect to view a distribution of the answers provided for a particular question.

For open-ended questions, before viewing the grades with the utilities described above, the user needs to use a separate grading utility. The interface used in this utility is shown in Figure 6. The faculty member can select the number of student submissions that appear at one time. Following each student submission a feedback text box is provided. The user can provide the student with a grade, the correct answer and comments. Some automation tools are provided to help expedite the grading process, to help collect information about the student performance, and to save student submissions for Just in Time Teaching (JiTT) strategies (Novak 1998). A default grade can be assigned to all shown students at once. Furthermore, the correct answer can be provided to all students at once. The grader can override the provided correct answers by typing a new one or by extracting the answer from one or several student answers. Student answers with particular pedagogical value can be saved on a separate web page for later retrieval. Common teacher comments can be saved and later retrieved, edited and re-used. Finally, even though student submissions appear for grading anonymously, information about the student including an email address and a picture can be easily obtained.

The Lecture Question is:

How can you obtain instantaneous acceleration at a particular time from a graph of velocity versus time? Be precise with your words.

The Correct Answer:

Replace Current Solution

A: B: C: D: F:

Comment for all Wrong:

Comment for all Right:

Check this box if you want to save these grades as defaults.

The Student Answer is:

By getting the slope of the tangent at that point.

Grades: [A] [B] [C] [D] [F]
 [A] [B] [C] [D] [F]

+ to answer
Comments
Question
save
Student

Figure 6. The figure shows the grading interface for open-ended questions. Tools are available for: grading several students at one time, easily providing individualized feedback, and saving submissions for JITT strategies

ITAL or PERC's Laboratory Interface

ITAL, PERC's laboratory interface was developed in 2002 and used for the first time during the Fall 2002 semester. It was developed through a need to manage the online publication of the laboratory manual and was supplemented with utilities to help manage laboratory grades. Even though it was designed to be used with PERC, ITAL can be used separately.

Online Publication of the Laboratory Manual

The Physics department at Mississippi State University uses locally authored laboratory manuals for teaching introductory courses. In the past, these manual were printed by the university printing services and sold to the students by local bookstores at nominal fees. The department and faculty authors did not get any profits through the sale of the manuals. Changes in equipment and teaching strategies require a regular update of the manuals even though the department was not getting any funds to pay for the update. The solution came in the form of the online publication of the manuals. In this case, the student purchases a voucher from the bookstore for an online version of the manual. Most of the profits in this case go to the department. Access to the online manual is provided through PERC. The voucher is authenticated by the department's laboratory manager through PERC's ITAL utility.

Laboratory Grade Management

Introductory classes at the department Physics and Astronomy at Mississippi State University are organized in lecture sections and laboratory sections. The instructor of record and the one responsible for the grades assigned in both lecture and laboratory components of the course is a faculty member. Enrollment for lecture sections is usually close to 60 while enrollment for laboratory sections is capped at around 20. For high enrollment introductory courses, sections of the same course are taught by different faculty members. Student enrollment in laboratory sections is not correlated with lecture sections. In other words, a student enrolled with one professor can be attending the same laboratory section as a student enrolled with another professor. In the past, the teaching assistant had the responsibility of collecting the student grades for each of the lecture sections and submitting them to the professor of record. This daunting task was done usually once a semester.

With ITAL, teaching assistants need to submit their grades to the ITAL database without having to identify the lecture section each student is enrolled in. The grade submission interface calculates for them the average grade for each student, the average grade on each laboratory assignment, as well as the average laboratory assignment grade for each of the other laboratory sections. They are asked to submit grades on a weekly basis. Faculty can view the grade for each of the laboratory sections, but can also retrieve the laboratory grades for the students enrolled in their lecture section. In the latter case, the grade is followed by the laboratory section number and a link to the email address of the teaching assistant of that section.

Administrative tools included with ITAL are:

- Utilities to set-up the laboratory sections.
- Utilities to set-up the lecture section (if it was not done through PERC.)
- Change of password utility for Teaching Assistants.
- Password retrieval utility for Teaching Assistants.
- Grade correction utility for the department's laboratory manager.

Modular Approach

From the onset PERC was developed in modules. Each of the tasks is completed through one or more modules. Currently, PERC is made up of 300 such modules. These were written in the PERL programming language. To limit the computing resources required for running PERC we have elected not to use a database engine. We instead organize the data in hierarchical structure of text files and folders. We have also judged that by using this format, through the use of simple routines, we can easily convert the data to any format we want and any time we need to.

The modular approach had made it easy for PERC to evolve and improve. For instance, detailed solutions were not initially provided with the online assignment delivery mechanism of PERC. A few lines of code added to the corresponding module made that possible. Small changes made it possible to allow students to re-submit modified versions of homework questions an unlimited number of times without penalty. Furthermore, the addition of new modules, like ITAL's modules, or faculty specific modules, is easy.

Student Feedback

PERC was used for the first time during Fall 1999. Since then, about 2500 students have used the authenticated features many more have used the other utilities. Feedback data collected during each of the semesters was used for corrections and enhancements. Because of limited resources and time limitations, survey data was not solicited from all students. Furthermore, the changes in PERC make data from prior semesters obsolete.

In the following, we present data collected from a survey administered at the end of Fall 2002 semester. We have solicited feedback from 110 students only 60 have responded. The long survey asked them about their background, their impressions about each of the tools used in the course as well as their

impression of what they have learned in the course. We will focus on their impressions of PERC and their attitude about web-enhanced courses.

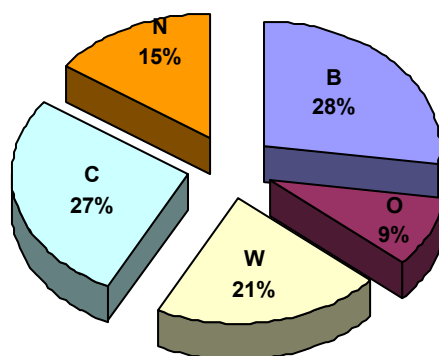


Figure 7. Tools used by students who have completed an online course or a web-enhanced course other than the physics course. B: Blackboard, W: WebCT, C: a course management utility like WebCT or Blackboard and personal web pages by the teacher, O: other, N: none

Most of the respondents are engineering majors, 49% sophomores, 72% males, 89% of them judge their ability in using computers good, very good or expert. 92% have access to a computer from their home or dorm room. 33% have taken a totally online course from another department before enrolling in this course. They were all enrolled in the mechanics portion of the calculus based introductory physics course. All respondents were taught by the same professor in a Web-enhanced course format.

During this course, they had to complete pre-lecture quizzes, homework and weekly practice quizzes online as well as two online tutorials in kinematics. They had access to printouts of the Microsoft PowerPoint slides used in class, copies of old and practice tests and to an online message board. By the end of the semester, the course message board included 550 message threads, most of them were initiated by students and most of them discussed homework problems. Interchanges in each of the threads varied from a couple of replies to about 40 replies. Data about the use of the message board will be published later.

For the students who have completed an online or a web-enhanced course, Figure 7 provides information on the tools they have used outside the physics department. Information about these tools is available at reference (Landon 2002). 76% of these students had experience using WebCT or Blackboard.

Figure 8 illustrates how the students compare PERC to the other course management tools available to them at our university. When asked to compare the use of the Web in this particular course to the use of the Web in other courses, 69% of them said that it is better, 28% said that it is the same and 3% said that it is worse.

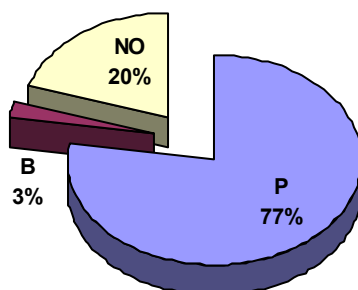


Figure 8. When asked to select the course-web interface that they like the best, the students made these selections. B: Blackboard, NO: no opinion, P: PERC

Figure 9 provides information about student impression on web-enhanced courses. Similar data is obtained when students were asked to compare their learning in web-enhanced courses to their learning in regular courses. Interestingly, when asked to rate the statement “I prefer totally online courses to regular courses”, 52% of these students selected “Disagree” or “Strongly Disagree” only 16% selected “Agree” or “Strongly Agree.”

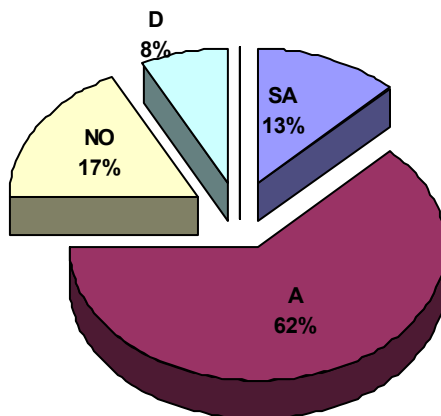


Figure 9. Survey data submitted by students when asked to voice their opinion about this statement: “I prefer web-enhanced classes to regular classes”. SA: strongly agree, A: agree, NO: no opinion, D: disagree. No one has selected “strongly disagree.”

Finally, it is worth noting that in ten semesters of use, PERC’s webmaster has received less than 100 emails requesting assistance. These emails were either sent directly by the student or forwarded by the student’s instructor.

Faculty Feedback

Faculty feedback was collected informally. Most comment positively on the ability to report a problem or suggestion and have it addressed immediately. It helps that PERC’s features and evolution are based on their feedback and comments from their students. They also rave about the collaborative features of the online assignments and still wish that they can get help authoring new questions. Many complement the easy access provided through the local area network. The online upload utility was added after a faculty member had requested it. Despite the quirks inherent to the first time deployment of any software, even faculty members who prefer not to use technology in teaching have praised ITAL.

It must be noted that due to its evolving nature and due to the lack of resources, PERC does not provide a current and complete set of instructions. Some faculty members often allude to this shortcoming.

CONCLUSION

We believe that PERC is providing an easy to use mechanism to help faculty incorporate online assignments in their courses. The fact that it kept evolving will keep it as a viable alternative for years to come. While easy and cheap to maintain, some resources are needed to pay for the cost of computer upgrades. Even though PERC has managed to evolve despite the lack of funds, it is important to note that major enhancements cannot be accomplished without additional resources.

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