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ABSTRACT

As the University of Arizona implemented its curriculum reform initiative, faculty became much more planful about their teaching, but also much more demanding of credible advice about instruction. Faculty make sometimes paradoxical demands in these circumstances: demands for tools that make it easy to do new things, and demands that these tools be accompanied by documentation of their effectiveness that can only be obtained after the tools are put to use. In order to respond to these demands, the main strategy was to build a learning community among faculty, using an online instructional support system, POLIS (Project for On-Line Instructional Support), both as a platform for dissemination of new ideas about teaching and learning and as a device for continuous collection of data on strategies and outcomes. The current version of the system is available on the World Wide Web; it is both a production site for University of Arizona courses and a demonstration site for public use. It is a Web course construction kit that allows instructors to build a course on the Web for immediate delivery to students over the Web. This paper describes POLIS, how POLIS disseminates advice about teaching, and how POLIS gathers data on teaching and learning. Contains 11 references. (AEF)

Supporting Planful Teaching: Embedding Instructional Design in Ongoing Assessment

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Starting about four years ago, the University of Arizona began a major initiative to try to reform teaching practice and to rebuild serious scholarly interest in teaching. The central component of this initiative was reform of the general education curriculum, which has now been completed. But an important offshoot of the initiative was a re-examination of teaching and its importance relative to other areas of faculty responsibility. Tenure and post-tenure review procedures were rewritten to weight teaching more heavily in evaluation and to require more documentation of teaching effectiveness and more explicit defense of teaching choices. Workshops and symposia were offered on such instructional designs as cooperative and collaborative learning. Study groups were formed to try to figure out how the university could become more 'student-centered.' Grants were awarded across campus for competitively selected instructional innovation projects. Gradually, the idea spread that there might be a need for change in our routine teaching practices, and much interest began to center on the possibilities presented by the Worldwide Web and other electronic media.

In this changed institutional environment, faculty are becoming much more planful about their teaching but also much more demanding of credible advice about teaching. Urged by instructional designers and information technology specialists to experiment with educational use of the Worldwide Web, faculty raise challenging questions about the value of new technology and about the balance between effort and return. They want to know whether investing in development of materials for the Web will pay off in any sense: whether it will improve learning, and if so, whether the improvement will be substantial enough to compensate for the time invested in development and for resistance from students. Many have heard from colleagues of the frustrations of building elaborate websites for classes that students never visit or, worse, visit but regard as useless.

Even faculty who are intent on improvement are often leery of change. This paper documents an effort to respond to the sometimes paradoxical demands faculty make in these circumstances: demands for tools that make it easy to do new things, and demands that these tools be accompanied by documentation of their effectiveness that can only be obtained after the tools are put to use. Our main strategy has been to try to try to build a learning community among faculty, using an online instructional support system both as a platform for dissemination of new ideas about teaching and learning and as a device for continuous collection of data on strategies and outcomes.

The Support System: POLIS

POLIS stands for "Project for On-Line Instructional Support," and the current version of the system is available on the Worldwide Web both as a production site for University of Arizona courses and as a demonstration site for public use (Jackson, 1996). POLIS is a web course construction kit that lets instructors build a course on the Worldwide Web in any subject, for immediate delivery to students over the Worldwide Web. No special training is required to use POLIS. 75 distinct courses were mounted on POLIS for Fall 1997, despite a complete absence of training programs or advertising. Instructors found the tools through word of mouth, search of the University's website, or direction to POLIS from the University Teaching Center. Most instructors never need assistance of any kind in using the system.

To build a course, the instructor visits a certain website and creates interactive web pages using POLIS resources. The resources include things like student-built bibliography and webliography, support tools for student study groups and student project teams, and several varieties of discussions. Instructors can also upload their own hypertext or multimedia content and link or embed these in POLIS resources, or they can use POLIS tools from within an independently maintained website. Although there is considerable flexibility within POLIS, a beginner can create an entire course without dealing with any of the complexities normally associated with web publishing.

The ease with which POLIS can be used is an important design feature of the system, but it is not the most important feature of POLIS. The most important feature of POLIS is that it allows for creation of highly sophisticated interactive dialogues on any topic, again without requiring any web programming skills. All resources in POLIS, but especially the interactive dialogues, aim for "significant" interaction requiring thought and effort (Milheim, 1995-96), mostly in the form of free verbal resource to questions and arguments.

At present, POLIS offers four well-defined dialogue types (in addition to a general-purpose threaded discussion format). Known as "POLIS lesson protocols," these dialogue types are online simulations of interaction sequences known from prior research to be effective in traditional classroom settings. Each online protocol can be described as a sequence of display and response elements (Jackson & Madison, 1997).

One-Minute Essay. In traditional classroom settings, the one-minute essay involves simply having students write for a very short time on a topic covered in the lecture or discussion, sometimes as a way to develop materials prior to discussion and sometimes to summarize, integrate, or reflect on materials already covered (refs). The online version has two required elements (a prompt and a student response) that can be elaborated with an optional display of student writings, shown before or after the student's own submission. As compared with the inclass version, the online version has two potential advantages: its adaptability for asynchronous interaction and its automatic archiving and publication of student writings.

Recitation. A standard recitation is a question/answer/assessment sequence. Although this familiar protocol has fallen out of favor as constructivist ideas have taken hold, it remains a popular tutorial sequence. The POLIS online recitation has four elements: the question, the student's answer, a "model answer" to which the student's own answer can be compared, and a self-assessment. Like the One-Minute Essay, the Recitation protocol can include optional elements such as display of any amount of background information in text or multimedia, and it can include display of other students' writings at any point in the response sequence. As compared with an inclass recitation, the online version has the advantages mentioned above, plus the advantage of allowing every student to give an independent answer to every question in a set of exercises.

Adversary. Responding to many recent calls for an increased reliance on argumentation in learning, especially in the sciences (Kuhn, 1993; Kuhn, Shaw, & Felton, 1997; Pontecorvo, 1993; Meyer & Woodruff, 1997; Zeidler, 1997), POLIS offers a simulated online debate protocol in which students are invited to stake out positions and defend them against counterarguments written by the instructor or selected from other students' writings. The Adversary protocol's elements are as follows: description of a controversy; student selection of a standpoint and preliminary defense of that standpoint; presentation of an opposing argument; student reaction to opposing argument; and student reconsideration of standpoint and explanation for changing standpoints or standing pat. Any number of opposing arguments can be presented for the student's reaction. The next revision of this protocol will also allow for review of other students' arguments on either side of the issue.

Virtural Peer. Based on Mazur's (1997) ConcepTest protocol, the Virtual Peer is an alternative format for incorporation of argumentation into courses in any subject. Mazur's protocol, as used in traditional classroom settings, has 6 distinct elements: presentation of a problem with a set of candidate answers; silent reflection by students; commitment by each individual student to one of the candidate answers; argumentation among pairs of students trying to convince one another of the correctness of their answers; reconsideration of candidate answers; discussion of the correct solution and reasons why other candidate answers are incorrect. The online version presents the problem with a set of candidate answers; asks for the reasoning leading to the selected answer; presents contradictory reasoning favoring each unchosen alternative and asks how the student would respond to a classmate reasoning in this way; presents the candidate answers for reconsideration and asks for reasoning supporting the student's new answer; and finally presents the correct solution. The online version sacrifices live interaction with peers, but improves on the live version by assuring that every student will have to respond to reasoning that differs from his or her own and by assuring that this reasoning will present significant intellectual challenges.

How POLIS Disseminates Advice About Teaching

When instructors open their lesson composer in POLIS, they are presented with choices among four supported protocols, and along with structural descriptions of each protocol they see a short passage containing "Recommendations." The recommendations give a very short summary of the research basis for the protocol, explaining its origination and whether it has been shown to enhance learning. For example, the recommendations accompanying the Virtual Peer protocol read as follows: "No-tech inclass version has been shown to be very effective in teaching both science concepts and problem-solving. Online version allows for close control over the 'peer' contributions to learning." The recommendations accompanying the One-Minute Essay protocol point out that the contributions of routine writing to learning do not depend on whether an instructor grades each piece of writing.

Instructors come to POLIS as an easy way to create interactive course materials on the web. However, their

actual engagement with POLIS has the potential for more profound and pervasive change in teaching practice, and this potential follows as much from the design of the authoring tools as from the design of the protocols themselves. Two features of the design of the authoring system are significant for the present discussion.

First, the display of four distinct protocols, each described in terms of its display and response elements, draws attention to a more abstract process of lesson planning. The four protocols do not exhaust all of the possible teaching/learning dialogues that can be composed once an instructor begins thinking strategically about forms of interactional engagement. The recommendations draw attention explicitly to the features of each protocol, and more importantly, they draw attention to the possibility of using these protocols in traditional classroom settings as well as in online applications. So the lesson construction tool is not just an authoring tool, but also a learning environment for teachers, a place where they are introduced to a relatively unfamiliar way of thinking about lesson planning that can be assimilated into practice in many ways.

Second, the recommendations emphasize the theoretical and empirical justification for each protocol. The recommendations explain what grounds there are for believing that these protocols will produce effective lessons. The inclusion of a protocol in the POLIS lesson composer is a sort of institutional stamp of approval for the use of these kinds of interactions in teaching. Protocols that have produced negative results in research (Marttunen, 1992) are not supported within POLIS. However, even for protocols that have been included, the stamp of approval is clearly provisional, subject to revision as experience with the online protocols either confirms or contradicts experience using similar protocols in traditional classroom settings. The design of the authoring environment is meant to emphasize that planful teaching has grounding in research and reflection.

POLIS is officially a support system for online instruction, meant to assist instructors in moving coursework onto the web. It should be obvious, however, that the support tools and the learning environment they create have the potential to alter the way instructors plan for face-to-face meetings with their students.

How POLIS Gathers Data on Teaching and Learning

We mentioned earlier that POLIS does not simply disseminate what is currently known about teaching and learning, but also allows us to continuously accumulate data on these processes. Most POLIS data collection is completely unobtrusive. When teachers use the POLIS tools, their activity leaves records in the form of specific objects built for their classes, such as lessons. When students work within POLIS, their activity creates responses archived within the course directory. Both instructors and students generate logs of use and of movements from page to page within a site. Additionally, new quiz and survey tools built within a related system (tentatively known as WILBUR) allow us to gather self-report data of any sort from students and instructors.

The lessons constructed by POLIS instructors and the choices they reflect can be analyzed both quantitatively and qualitatively at any point in time. A search tool designed to allow instructors to locate relevant examples of each dialogue type also allows us to determine how frequently each lesson protocol is being chosen. These can be cross-classified with the type of subject being taught to build knowledge about the fit between protocols and subject matter. For example, the Virtual Peer is modelled explicitly after a protocol developed for the teaching of physics, but it is by no means limited to that field and has yet to be used in a science course at the University of Arizona. It has, on the other hand, been used extensively in social science courses, and it could be adapted to courses in any area. We can also examine the content of the protocols for internal evidence that instructors are attempting to appropriate the structures for other than their intended purposes. We found early on that instructors in some fields were using the One-Minute Essay framework to post announcements and assignments, setting the number of prompts to "0" to suppress the production of a student response page. In effect, this means that instructors *chose* to make their web resources noninteractive. To discourage this way of using the protocols, we added separate tools for posting assignments and announcements, but we have not yet been successful in getting instructors in math and science fields to use online writing to support learning.

Student responses and logs function similarly as sources of data. By examining and content analyzing student writings, we can recover surprising information on how students orient to the various features of the protocols. For example, we have discovered simply by examining automatically generated archives and logs that our original design for the Recitation protocol has the unintended effect of making the "model answer" seem to be the point of the lesson. Stripped down to its structural minimum, a recitation has three required elements: a question, a candidate answer, and an evaluation. Our online implementation of the recitation originally consisted of these three elements, with the answer taken as open-ended essay and the evaluation offered as a "model answer" returned when the students submitted their answers. In many situations, getting the "right" answer is of relatively little importance compared with having a chance to compare a candidate answer with an expert model.

Unfortunately, we have found through examination of logs generated as byproducts of the students' activity that they routinely skip to the model answer before giving their

own answer. Checking input to be sure the student has made an answer is useless, since students can simply enter a nonsense string. Adding a fourth step to the protocol in which students are asked for their reaction to the comparison of their own answer to the model has also done nothing to fix this defect: students who have simply copied the model answer into the response space will assert proudly that their answers were "exactly right," since they matched the model exactly. The lesson they are learning is "exactly wrong," of course, and knowing this, we can tinker with the protocol to try to prevent it.

Although surprising amounts of information can be recovered unobtrusively, from records generated automatically as byproducts of teaching and learning, we do also gather data systematically and overtly using online surveys and questionnaires. POLIS went into production in Fall 1996. By Spring 1997 we had an end-of-semester questionnaire for instructors to complete, reporting on their experience with POLIS. Unfortunately, the number of courses using the system was still rather small, and among these the response rate to the survey was low. Consequently, we learned relatively little from these questionnaires compared to what we learned from the unobtrusive data. Much of what we learned from the questionnaire data could have been learned from direct examination of usage data: for example, instructors gravitated first to the information tools (webliography and bibliography), overlooking entirely the powerful interactive capabilities of POLIS. Not surprisingly, instructors found it easiest to adopt the "stage one" tools that closely resemble their prior teaching practices than the "stage two" tools that attempt to induce new practices (Hall, 1993). Survey data from Fall 1997 are not available at this time, but even without survey data a trend toward increasing use of the dialogue and discussion tools is evident.

Assessment and database tools being introduced for Spring 1998 as part of the WILBUR initiative will greatly expand our ability to evaluate impact on student outcomes. These tools will enrich the authoring environment by adding the capability of building quizzes, tests, and surveys for courses and other uses, and by linking data drawn from responses to these instruments to POLIS archives and to other information systems. As with the current data sources in POLIS, these assessment tools will generate data as byproducts of teaching and learning. For example, a quiz used to assess a student's comprehension of the material contained in an online lesson will serve secondarily to help us evaluate the effectiveness of the lesson design.

Conclusion

POLIS was designed to make teaching on the web as easy as possible and to work well within the ordinary preparation and planning practices of teachers. The authoring tools are available to instructors 24 hours a day from any point of access to the Internet, and they make instructors completely autonomous web publishers, independent of consultants, network administrators, programmers, or other support staff. Ease of use and ubiquitous availability to the instructor is crucial to the usefulness of the system as a platform for disseminating current knowledge about teaching and learning and as a device for gathering new data on what works.

Instructors come to POLIS for the authoring tools; but in using the tools they learn about new teaching strategies and they contribute information automatically that helps refine our knowledge about teaching practice and learner outcomes. Students come to POLIS for the lessons and other resources; but in doing their work they too contribute data that we use for evaluation of the tools themselves. This interweaving of instructional support and instructional assessment allows us to build a self-correcting system whose development directions emerge constantly from examination of teaching practices and learning outcomes.

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