Abstract – The Expertiza platform is a divide-and-conquer approach to producing reusable learning objects through active-learning exercises. Students select from a list of tasks to be performed, with several students selecting each task. Then they prepare their work and submit it to an electronic peer-review system. The work is then reviewed by other students, who offer comments to help the submitters improve their work. The best submissions for each task are then selected for use in later courses. Expertiza gets students working together to improve others’ learning experiences. It helps them learn, by making them think through the lecture material and apply it to a real-world situation, just as they might do in an on-the-job situation. These learning objects can be improved iteratively; for example, the next year’s class can be presented with the examples developed by students the previous year, and asked to identify shortcomings and develop improved examples. This paper presents numerous examples of how the platform can be used to allow each cohort of students to “stand on the shoulders” of their predecessors, building ever-more-effective resources to help themselves learn.

Index Terms – Active and cooperative learning, peer review, reusable learning objects.

INTRODUCTION

Most homework assignments can be viewed as so much redundant effort. Students are all assigned the same work; they do it, and submit it for evaluation. It is graded, and then discarded, never benefiting anyone except the student who did it.

As long as work is to be graded by a single individual, or a small team of teaching assistants, it is essential that students do the same work, because there are economies of scale to grading. After the grader surmounts a steep learning curve, the rest of the homeworks can be graded much more quickly. The scope of assignments is limited, and the amount of feedback is limited by the fact that all of the feedback must be given by a small number of individuals.

Now suppose that students are involved in the review process, giving feedback to their peers. Since each reviewer need review only a handful of submissions, more copious feedback can be given. It is possible to have multiple rounds of review, where students are asked to revise their work based on the feedback they have received, and then be reviewed again. Peer review in the classroom has been the subject hundreds of academic studies. Many of these studies found that students felt that peer review made them think more critically and find the work more challenging [1, 2].

In recent years, several software packages for peer review have appeared. Some have been integrated into LMSs; and some are standalone systems, such as Calibrated Peer Review [3]. When using an electronic system, economies of scale do not demand that all students do the same homework. Instead, students can select from among a set of related assignments, with each one choosing a piece of a larger project. For example, the project might be to write formative-assessment questions [4] over all of the lectures in a semester, and each student might choose one lecture. In a large class, several students can choose each piece of work. After the review period is over, the most highly scored contribution can be chosen for each of the pieces, and presented to students in a subsequent semester. Our Expertiza platform (research.csc.ncsu.edu/efg/expertiza) extends peer-review software to allow students to choose a task; and after review is complete, it selects the best contributions and aggregates them together.

EXPERIMENT: HELPING A TEXTBOOK AUTHOR

In Fall 2005, the author’s class in Object-Oriented Languages and Systems used a prepublication copy of a textbook on object-oriented design [5]. In an effort to help the author improve the text, three peer-reviewed assignments were given. In one of the assignments, students were asked to improve an explanation of one of the more difficult topics from the textbook (we discussed in class which were the most difficult topics). In a second assignment, students were required to give another example of a concept introduced in the textbook. In the third assignment, students made up an exercise on material covered in some chapter of the textbook (they signed up for a particular chapter). Roughly one third of the class did each of the three tasks for their first assignment, and then did the remaining two types for later assignments. Thus, about 26 of the 78 students in the class were doing each type of work for each assignment.

To further polish the student submissions, we added a “playoff” round to each assignment. The best 8 submissions for each kind of work made the playoffs—which consisted of two more rounds of review by students who did not review in the earlier part of the round. The “winning” submission in
each category received 50% extra credit; the runner-up, 25% extra credit; and the others in the playoffs, 10%.

At semester’s end, students were surveyed on whether they learned a lot from these assignments. Forty-nine of the 78 students responded, and 29 of them said they did. Only 10 said they did not [6].

**OTHER EXPERTIZA EXPERIMENTS**

Here is a sampling of the many ways in which the Expertiza platform can be used. Most of these have either been tried in the past, or are being used this semester.

1. In a service-learning course, students submit reports on their experiences. These are peer reviewed, and their peers are asked to select comment on experiences that they have also had. Descriptions of common experiences and how they were dealt with are collected together in an FAQ to serve as a resource for the next semester’s class.

2. In an advanced graduate course, students are asked to select readings over various topics covered in the course. Their selections are peer-reviewed by other students, with the winners being chosen as topics for survey papers. The next assignment, teams of students write survey papers on the chosen topics, and these are peer-reviewed. The best of these are published in the "class proceedings," and are used as study materials for the next offering of the course. The proceedings help familiarize students with this area of research, without the need to read all of the research papers that the previous class reviewed.

3. An instructor provides PowerPoint lecture notes to his class, and has each student sign up to annotate a particular lecture—by providing hyperlinks to definitions, more detailed descriptions of particular points during lecture, and examples of the concepts that are presented. The best of these become part of the class Web site in later semesters.

4. Students are assigned to do readings and fill out a topic map based on what they have learned. These are peer-reviewed, and improved in response to those reviews. Since the topic maps cover different subjects, they can be linked together into a topic map of the entire course—kind of a cross-referenced encyclopedia of the course material.

5. Students in my Ethics in Computing class each research a particular topic and come up with a hyperlinked list of articles and a study guide. The best work is selected for our Ethics in Computing site (ethics.csc.ncsu.edu),Google's top hit for "ethics in computing".

6. Many instructors have begun to use Wikis in their courses. If done well, the work the students produce is a reusable learning object. Yet review of student contributions is very time consuming. A recent enhancement to Expertiza allows students to submit Wiki pages for review by other students. Not only do the students get more feedback on their contributions, but they have the opportunity to go through multiple rounds of revision and review.

7. Expertiza can be used for code reviews in programming classes. In Fall 2006, my Object-Oriented Languages and Systems class, students will perform a “competitive refactoring” experiment. Each student will choose a code module, and will try to improve its design by applying several refactorings [7]. Then peer reviewers will evaluate the work of several students who chose the same module. After seeing the improvements made by several students, they will be in a good position to advise the students on how to improve their code further. In the end, the most-improved version of each module can be incorporated into the software system. The software system we will use will be Expertiza itself!

Used in this way, Expertiza has much in common with the open-source model of software development, in which code gets better as many eyes look at it and try to enhance it.

**SUMMARY: ADVANTAGES OF THE EXPERTIZA APPROACH**

Expertiza offers many advantages for student learning, teaching, and resource utilization. 

*Student learning.* Expertiza offers a way to integrate active and cooperative learning into courses. Having many milestones encourages students to keep up with their studies, which is an advantage especially for students with poorer study habits. Moreover, the need to review and revise makes it difficult or impossible to plagiarize solutions. Finally, the electronic review system can extend these cooperative learning activities to distance education.

*Teaching.* Expertiza facilitates formative assessment. It helps instructors create fresh examples and exercises for their classes. This is particularly helpful in advanced courses that need to keep up with technology.

*Resource utilization.* Expertiza helps free TAs from grading, allowing them to work more with individual students. It allows an instructor to assign an adequate amount of homework, even with inadequate TA support. Best of all, it makes teaching large classes an advantage, as these classes will create more and better learning objects that can be used to improve instruction in the future.

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**REFERENCES**


