

2005-2007 LITRE Grant Proposal

1. Project Title:

Assessment of Expertiza: A Methodology for Building Reusable Learning Objects Through Peer Review

2. Project Coordinator:

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4. College or Unit:

Engineering

5. Department:

Electrical & Computer Engineering/Computer Science

6. Project Description:

This project is to assess the benefits of the Expertiza platform. Expertiza is a suite of software applications for developing reusable learning objects through peer review. Students select a homework project from a list of tasks (e.g., create an example of a particular concept from the textbook, or make up a problem over the material covered in this lecture). The number of tasks is limited, so that several students will select the same task. Their work is reviewed by their peers, and they revise it based on feedback they receive. The reviewers then assign a score to the revision. For each task, the submission rated most highly is then "published," i.e., made available to other students in the class, and students who take the same class in later semesters. This project will assess the benefits of this approach, and refine it based on our experience.

This project builds on work done on my 2004-05 Instructional Grant, which was to disseminate my peer review application PG throughout the university. PG has now been used in several different departments and colleges, and the feedback received via focus groups has been used to improve the usability of the application. PG is the middle part of the Expertiza suite, which includes

- Shimmer, an electronic "signup sheet" that allows students to select a homework task and informs PG of which task has been selected.

- PG, which is used by students to peer-review other students' work, and
- the Conoscenza Course Database, which serves as a repository for the "published" student work.

This year's proposal is to assess the benefits of the Expertiza approach. 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. Moreover, they are explaining the concepts to their peers, thus gaining valuable writing experience. 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 allows each cohort to "stand on the shoulders" of students in earlier classes, with an ever-improving set of materials to help them learn.

This model of homework represents a real paradigm shift. Traditionally, homework has served only for students to demonstrate mastery of the subject. All students perform the same tasks, rendering their effort redundant, in some sense. Their work is graded and then "thrown away," never benefiting anyone but the student who did it. By contrast, Expertiza can automatically publish the best work, so that others can benefit from it.

These results can only be produced with electronic peer review. The overhead of manual hardcopy review would be too great. The Expertiza platform handles dividing the work among the students, assuring that enough students choose each piece of work; this makes it likely that at least one of the submissions for each piece will be "good enough." Peer review distributes the effort of grading among the students; this is important, because the burden is much greater if the students are doing many different assignments.

The Expertiza software is being has been, and is being, developed by student projects in my object-oriented computing course (CSC/ECE 517). I have an Instructional Computing grant for 2005-06 to disseminate the platform to several other classes. However, the project description for that grant does not mention assessment, and indeed, the scope is insufficient to assess the impact of the project in any formal way. The student hired for that project will spend most of his/her time helping instructors to set up assignments, and helping students with the system, rather than evaluating the result. The single-AY timeframe is insufficient to do "before and after" assessments of student performance in courses using Expertiza. The 18-month timeframe of the LITRE program will provide adequate time to develop publishable results from the Expertiza approach.

7. Project Objectives:

The first objective is to evaluate the Expertiza platform's ability to increase the amount of material that students learn, and how much they retain. This will be accomplished using peer-reviewed homework to increase student engagement in the learning process. When working on a typical homework assignment, students do the work and submit the homework for evaluation. By adding the

peer review aspect, students are able to see what other students have submitted, and are forced to engage the material more critically.

The second objective is to create learning objects that will add value to courses through students' use of peer review and the Expertiza platform. That is, as part of their course, students will help develop material to be used in the course the next time it is offered.

Identifying different patterns of use is the third objective. It is expected that faculty will adapt Expertiza to their specific needs. by doing so, they will create new patterns of use of the software and expand its usefulness for the future. The Expertiza software is continually under development and improving. While this proposal does not cover the development of software, the usage patterns and feedback from students and faculty will be of great help to the software developers. This information will be collected through surveys and interviews. The ability for comments and suggestions will always be open to students and faculty.

The final objective is to produce documentable and publishable results. The outcomes of these experiments will be written into papers, and published. The purpose of this objective is to provide our results to others who would find them useful.

8. Estimated number of students affected:

Two experiments are planned now. In CSC/ECE 517 (100 students/yr.), I am having students develop resources for a soon-to-be-published textbook on object-oriented design [Skrien, Dale, An Introduction to Object-Oriented Design and Design Patterns Using Java]. During the semester, each student will be required to do three cooperative exercises: to make up an example illustrating a concept covered in the text, to improve a section of prose, and to write an end-of-chapter problem. The best submissions will be transmitted to the author for possible inclusion in the text.

In ENG 331 (500 students/yr.), students are assigned to write on technical topics. Sections (22-23 students each) will be paired, with one section using the Expertiza approach and one not using it. The Expertiza sections will be given a set of topics to choose from. They will write technical prose on these topics for a client. The performance of the Expertiza sections will be compared with the performance of the non-Expertiza sections.

The proposer has used PG and will use Expertiza in his other courses:
(Course #, title/instructor/ e-mail address@ncsu.edu/annual enrollment)
CSC 379/Ethics in Computing/Gehring/efg/150
CSC/ECE 506/Architecture of Parallel Computers/Gehring/efg/60
ECE 463/Advanced Microprocessor Design/Gehring/efg/30
ECE 521/Computer Design and Technology/Gehring/efg/70
ECE 705/Memory Systems/Gehring/efg/10

Beyond that, several other instructors are interested in the project. We will solicit two or three of them to be involved in the project over multiple

semesters.

The following instructor has used PG and is definitely interested in using Expertiza to develop resources for her courses.

ECI 511/Computer Applications and Curriculum

Integration/Steelman/jane_steelman/20

ECI 513/Videography for Education/Steelman/jane_steelman/20

The following instructors have used PG in their classes, and may be interested in using the Expertiza platform in the future:

CE 484/Water Supply and Wastewater Treatment/de los Reyes/fldelosr/30

CSC 224/Discrete Mathematics/Barnes/tmbarnes/35

ZO 371/Developmental Anatomy and Histology of the Vertebrates

II/Black/betty_black/16

The following instructors have expressed interest in using PG, and may be interested in using the Expertiza platform in the future, however they have not yet committed:

ADN 402/Senior (Design) Studio/Plume/vita_plume@ncsu.edu/15-18

ARE 321/Agricultural Financial

Management/Oltmans/Oltmans-AW@are1.cals.ncsu.edu/65-80

CE 576/Air Pollution Control/Frey//10

CE 596K/Environmental Microbiology for Engineers/de los Reyes/fldelosr/10

CH 221/Organic Chemistry I/Wahl/george_wahl@ncsu.edu/750

CHE 475/575/Advances in Pollution Prevention: Environmental

Management/Grant/grant/25-30

CHE 596I/Colloid Science and Nanoscale Engineering/Velev/odvelev/32

CHE 761/Polymer Blends and Alloys/Spontak/rich_spontak@ncsu.edu/54

COM 456/Organizational Communication/Jameson/jameson/60

COM 526/Seminar in Organizational Conflict Mgt/Jameson/jameson/20

COM 556/Seminar in Organizational Communication/Jameson/jameson/20

ECE 464/ASIC Design/Franzon/paulf/30

ECE 520/Digital ASIC Design/Franzon/paulf/150

ECE/CSC 570/Computer Networks/Perros et al./hp@csc.ncsu.edu/54

ECE/CSC 573/Internet Protocols/Perros et al./hp@csc.ncsu.edu/53

ECE/CSC 579/Introduction to Computer Performance Modeling/Perros et al./hp@csc.ncsu.edu/22

ECE/CSC 775/Optical Networks/Perros et al./hp@csc.ncsu.edu/15

ENG 332/Communication for Business and Management/Larsen/jlarsen/23

ENG 333/Communication for Science and Research/Larsen/jlarsen/23

ENG 433/Screenwriting/Pramaggiore/maria_p/15

FOR 414/World Forestry/Sills/erin_sills@ncsu.edu/10

HI 216/Latin America since 1826 Slatta/Slatta/slatta/35

HI 453/US-Latin American Relations/Slatta/slatta/35

PE 273/Jazz Dance/Domingue/psdoming@gw.fis.ncsu.edu/60

ZO 361/Principles of Embryonic

Development/Brizuela/brenda_brizuela@ncsu.edu/30-50

9. Outcomes of the Project:

Outcomes for Objective 1, Evaluate ability of Expertiza to increase student

learning and retention.

Outcome 1a: Students will spend less time on specific difficult concepts the second time the course is taught.

Outcome 1b: Student engagement in the course will increase when Expertiza is used.

Outcomes for Objective 2, Create learning objects that will add value to courses.

Outcome 2a: Have four or five courses (including the proposer's) participate in the project in AY 2005-06.

Outcome 2b: The students from the courses will create the material identified by the faculty member. The material will be critiqued by other students in the course around the concept of the material "adding value" to the course and to students' learning

Outcome 2c: Textbook publishers make use of the reusable learning objects.

Outcomes for Objective 3, To develop different patterns of use of the Expertiza platform.

Outcome 3a: Faculty develop a variety of different uses for Expertiza.

Outcome 3b. The Expertiza developers incorporate features needed by these faculty into the software.

Outcomes for Objective 4, Produce publishable results.

Outcome 4. At least three papers based on the results of this experiment are accepted by peer-reviewed conferences and journals.

10. Project impact on NCSU:

Viewing homework as a computer-mediated collaborative undertaking has beneficial consequences across the educational enterprise. It helps integrate active and cooperative learning into courses, including distance-education courses, and it discourages plagiarism. In 1996, the National Research Council [NRC 96] identified active learning as an essential practice in science education. Hundreds of studies report on the impact of active and cooperative learning in the classroom. Notable are the meta-analyses of Johnson et al. [JMJN 81, JJ 89], which indicate that cooperation is markedly more effective than individual learning, and the thorough annotated bibliography of Totten et al. [TSDR 91], which offers many examples to inspire faculty on how to integrate cooperative learning into their classes.

In a traditional classroom, active learning may take the form of short in-class exercises in groups, followed by reports from these group to the entire class. With Expertiza, electronic peer review by small numbers of students (on campus or via distance ed) is followed by presentation of the best contributions to the class. Active and cooperative learning is particularly helpful to at-risk students, women, and underrepresented minorities. Milem [Mile 01] concludes that "teaching practices associated with active learning" are one of the four

most important factors in maximizing the benefits of learning for diverse racial groups. One of the active-learning practices he cites is "student evaluations of others' work." A recent study of student engagement and student learning [CKK 2004] determined that student engagement (of which active and collaborative learning is one component) was most beneficial to the achievement of underperforming students. The authors conclude, "these findings suggest that institutional interventions to boost student engagement may have the greatest payoff for those most at risk for leaving college prematurely."

The Internet has enormously increased the opportunity for students to turn in work that is not their own. The Expertiza platform incorporates several strategies that have been recommended to diminish the risk. Multiple deadlines and milestones make it impossible to submit a finished product obtained from an external source [Ster 04]. The fact that students are doing customized assignments [CW 02] means that instead of being able to find a co-conspirator anywhere in the class, they are limited to only the small set of students who chose the same assignment as they did. Since the set is small, the same peer reviewer(s) can evaluate most or all submissions in this set, which makes cheating easy to detect.

Expertiza also facilitates "formative assessment" [Bost 02]--quizzes that offer feedback to students on their progress throughout the semester. Online testing systems such as WebAssign or the testing tool in WebCT allow computer-graded quizzes to be administered daily or weekly. Expertiza helps furnish material for these quizzes. , students can be assigned to create machine-scorable questions over lecture material, and these questions can be peer-reviewed by other students. The best questions can then be chosen for inclusion in mastery quizzes. In later semesters, the questions can be revisited, with students being encouraged to fine-tune them so that students who have a specific misconception choose a particular wrong answer, and then receive feedback on why that answer is incorrect [BKM 91].

In today's difficult budget climate, NCSU is battling to maintain quality academic programs. In many departments, there are not enough TAs to do much more than grade papers, let alone work individually with students. By offloading some of the evaluation work to the students themselves, TAs are able to devote more attention to students. Further, with peer review, the students answer some of each other's questions, relieving pressure on the course staff.

Most strikingly, with Expertiza, teaching large classes may become an advantage! Large classes can produce better and more abundant learning objects, improving students' learning experience rather than worsening it. The usual disadvantages of large classes—lack of engagement, less personal attention—are mitigated not only by better materials, but also by the use of active learning and by freeing more TA time for individual attention to students.

REFERENCES

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[Ster 04] Sterngold, Arthur, "Confronting Plagiarism: How Conventional Teaching Invites Cyber-cheating," *Change* 36:3, May-June 2004, pp. 16-21.

[TSDR 91] Totten, S., Sills, T., Digby, A., and Russ, P.. *Cooperative learning: A guide to research*. New York: Garland, 1991.

11. Project Assessment Plan:

Outcome 1a: Students will spend less time on specific difficult concepts the second time the course is taught.

Assessment plan: Ask faculty to identify difficult concepts, and survey students on the amount of time they spent studying each of these concepts.

Outcome 1b: Student engagement in the course will increase when Expertiza is used.

Assessment plan: Pose questions on engagement to students at the end of each semester. The questions will be similar to those used in the National Survey of student engagement. Students will be asked to fill out a survey on the Web.

Outcome 2a: Have four or five courses (including the proposer's) participate in the project in AY 2005-06.

Assessment method: Faculty will provide pre-assessment data, e.g., where past students have had difficulty with the course. Faculty will devise assignments for students to create material around these concepts.

Outcome 2b: The students from the courses will create the material identified by the faculty member. The material will be critiqued by other students in the course around the concept of the material "adding value" to the course and to students' learning

Assessment method: Compare students' work from the pre-use data with work from the first semester when Expertiza is used. Is it better?

Outcome 2c: Textbook publishers make use of the reusable learning objects.

Assessment method: Feedback from the publisher of the Skrien text regarding how helpful the students' input was, and how it could be improved.

Outcome 3a: Faculty develop a variety of different uses for Expertiza.

Assessment method: Monitor the ways that faculty have students help create material. The faculty will be surveyed twice during each semester on how they used the tool in the course

Outcome 3b. The Expertiza developers incorporate features needed by these faculty into the software.

Assessment method: Surveys of users of the software on ease of use. Compare quantitative answers from first-time users with the answers of these same users after requested revisions have been incorporated into the software.

Outcome 4. At least three papers based on the results of this experiment are accepted by peer-reviewed conferences and journals.

Assessment method: Editors' decisions based on peer reviews of our work.

12. Staffing and Support:

The bulk of the funding will go to one graduate student, to perform the tasks listed in the Project Description.

A small amount (~ \$500) will be used to pay participants in focus groups.

13. Financial Support Requested:

EPA salary total:

SPA salary total:

Other salary: 9500

Equipment:

Cost associated with assessment: 500

Other financial support requested:

Total Funds requested: 10000

Additional Explanation of how funds will be used:

Assessment costs are pay for members of focus groups.

14. Funding Breakdown:

Total funding requested for fiscal year 2005-2006: 4000

Total funding requested for fiscal year 2006-2007: 6000

15. Staff Support and/or Technical Support Requested:

We would like to consult with the Director of Assessment regarding our assessment instruments. This would be on an informal basis (e.g., e-mail and phone calls), mainly to get feedback on the questions we are posing to students and faculty.

16. Timetable for Implementation:

January-March 2006: Assessment of CSC 517 work on textbook enhancement.

January-May 2006: First-time use of Expertiza in ENG 331, ECE 463, and ECE 521, as well as two or three other courses.

May-August 2006: Assessment of Spring 2006 results. Submission of first papers to peer-reviewed conferences or journals.

August-December 2006: Second-time use of Expertiza in CSC/ECE 517 and ENG 331. Comparison of student performance with first-time use. Use of Expertiza in two or three other courses.

January-May 2007: Assessment of Fall 2006 results. Second-time use of Expertiza in two or three courses.

May-June 2007: Assembling of final results. Submission of work to peer-reviewed journals.

17. Human Subjects Protection:

If your proposal project involves research using human subjects, you will need approval from the Institutional Review Board for the Protection of Human Subjects in Research (IRB) prior to final approval. IRB information is available at <http://www.ncsu.edu/sparcs/irb>

**18. Proposal Release:**

By submitting this proposal the applicant grants the LITRE Advisory Board permission to make this proposal available as an example for future grant applicants. All personal information will be removed if this proposal is used as an example.

