

REFLECTIONS ON USING LEARNSTAR IN UNIVERSITY MATHEMATICS COURSES

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Competition can be a powerful motivational tool. Moreover, given the current fascination with TV shows such as “Survivor” and “The Apprentice,” even vicarious competition has tremendous power to command students’ attention. Recently, we attempted to capitalize on this fact by adapting the LearnStar interactive quiz system for use in the university classroom.

The underlying technology has been used for many years by elementary and secondary schools, and thanks to National Science Foundation CCLI Adaptation and Implementation Grant #0311617, we have begun incorporating into university-level courses. Bob Blake has revised the freshman chemistry curriculum at Texas Tech University to include LearnStar-based recitations. Joaquin Borrego and Lee Cohen have included LearnStar in both Honors Psychology and Abnormal Psychology. Our focus in the math department has been in adapting LearnStar to Calculus I and teacher preparation courses. We will describe how we have used LearnStar in these courses, indicate how effective it has proven, and reflect on lessons learned in the process.

LearnStar. The LearnStar quiz system allows students to compete in answering timed questions. The questions, typically multiple choice, are displayed to the class using a projector or large-screen TV. Students then respond using either 900 MHz wireless gamepads sold by LearnStar, Inc., PDA’s with wireless internet connections, or networked PC’s.

A counter in the bottom right corner of the screen counts down from 1000 while students enter their answers. If a student answers correctly, they earn a number of points equal to the value of the counter when they gave their answer. Thus the faster a student responds, the more points they can earn. If a student answers incorrectly, they lose 250 points. This penalty means there is no advantage to immediately making a random guess in an attempt to earn all 1000 points. See Figure 1.

Since students are required to log into the system using their student ID number, each student’s answers (and attendance) are recorded. While we did not use this information for when assigning grades, it can easily be used for that purpose.

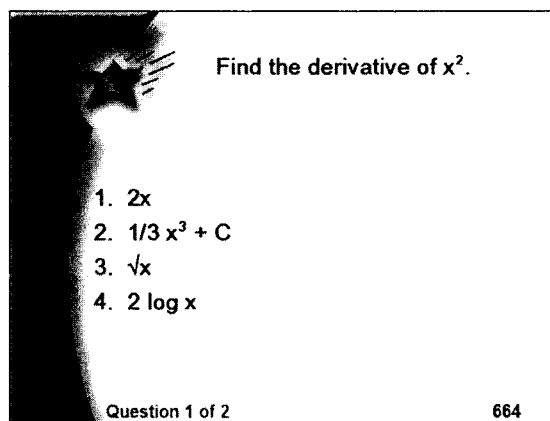


Figure 1. A typical LearnStar question used in our Calculus I course.

Calculus I. At Texas Tech University, Calculus has traditionally been taught in sections of 40 students meeting 3 hours per week. However, in the last five years, university enrollment has increased from just under 25,000 students to almost 30,000 students. This has led to growing pressure to increase class size. As a result, in the spring 2004 semester, we taught a section of Calculus I with 90 students meeting 3 hours per week for lecture and one and a half hours per week for recitation.

The 90 students met in three groups of 30 for recitation with a graduate teaching assistant. All three groups discussed homework questions and completed group activities. However, two of the groups also used LearnStar almost every week.

Our goal in conducting the competitions was not to test, but to teach. Students were not penalized or rewarded beyond seeing their names on the leader board at the end of each question. Frequently, the teaching assistant would stop the competition after a difficult question and discuss the reasoning behind the answer. The excitement of the competition then produced great interest in the explanation.

Students were typically given only 10 to 20 seconds to respond to each question. Thus some care was required to construct questions which could be answered very quickly and without the use of a calculator or even pen and paper. Questions which were especially amenable to inclusion in LearnStar competitions included

- Pre-Calculus Review
- Calculating Derivatives
- Evaluating Indefinite Integrals
- True / False Questions
- Definitions
- Quick Concept Questions

We found the pre-calculus review questions to be extremely helpful. As this was a Calculus I course in the spring semester, most students had a fairly weak background, especially in trigonometry. By shifting some of the review material into the recitations, we had more time in lecture for the new material.

Questions requiring the calculation of derivatives and integrals seemed to make a significant impact on our students. However, we also moved beyond simple drill and practice to concept questions such as “True or False? If $f''(2) = 0$, then $x=2$ is an inflection point.” or “If $f'(x) > 0$, then ...(f is increasing).”

Our preliminary statistical analysis of the results shows students in the LearnStar recitations performed better on the midterm exams and especially on the final exam. The difference was statistically significant for all except Exam II.

	Exam I	Exam II	Exam III	Final Exam	Homework
LearnStar	75	71.2	78.2	70.2	67.2
Non-LearnStar	63.7	64.6	68.9	47.7	69.1

Before the comprehensive final exam, the LearnStar sections replayed many of the competitions from earlier in the semester. This seemed to have been much more helpful than the question and answer session in the control group. The control group did not seem to be weaker students in general, however, as their homework average was higher than the homework average for the LearnStar sections.

Capstone Teacher Preparation Course. The second course which has benefited from the inclusion of LearnStar materials is our technology capstone course for elementary education majors. The goal of this course is to give future teachers experience with new technologies and create confidence that they can incorporate them successfully into their classroom. We discuss which technologies are most appropriate for various situations and the pedagogical implications of their use. The materials for the course were developed by Gary Harris at Texas Tech University [1, 2].

Most of the students who take this course are specializing in mathematics and will become middle school math teachers. However, they are notoriously difficult to motivate and tend to have very weak backgrounds. Thus we felt interactive LearnStar competitions were ideally suited to spark their interest.

We used LearnStar as both a tool to teach the course material and also as one of the technologies being studied. Students used competitions to review for the midterm and final exams and also wrote their own competitions over the material we discussed in class. By observing the material they included, the material they omitted, and any mistakes in terminology, the students' competitions provided valuable insights into their thinking. Finally, as part of their final project, each student researched the TEKS objectives required by the state of Texas to be covered in the grade they wish to teach. They then wrote competitions and a lesson plan for one of these objectives. See Figure 2.

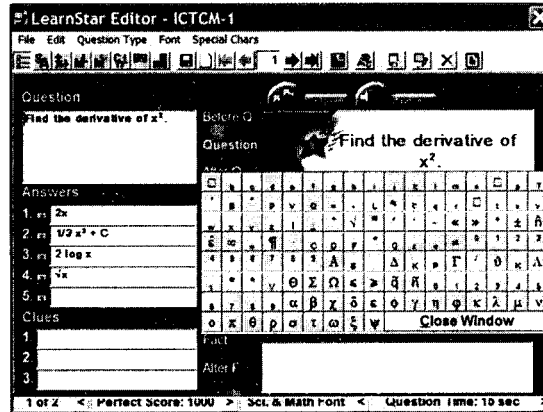


Figure 2. The LearnStar Competition Editor.

At the end of the semester, students were surveyed concerning their attitude toward LearnStar. All agreed with the statement “LearnStar is fun,” and 95.4% agreed with the statement “I would like to use LearnStar again.” When asked to rate how helpful LearnStar was in learning the course material on a scale of 1 to 5 (with 5 being the most helpful), the average rating was 4.23.

Reflections. There are still several limitations to the LearnStar software, most notably the very limited support for mathematical fonts and symbols and the 24 character limit for the answers to multiple choice questions. However, LearnStar, Inc. has promised to deal with these issues in the next release.

The gamepads remain rather expensive, but for classes like our Calculus I course which do not meet in a computer lab, they are very convenient. For classes which can meet in a computer lab, the networked version is a much more cost efficient option. Moreover, it also permits students to write their own competitions. As described above, this can yield extremely valuable insights into their understanding.

We have found most students respond very well to the competitions. Displaying the leader board listing the top 10 scores after each question provides powerful motivation. However, it seems best to display only the top 10 scores instead of the entire class. In this way the best students are rewarded without unduly embarrassing weaker students and students who might not respond as well to the pressures of competition.

References.

[1] Harris, Gary. “A Comparative Technology Course for the Prospective Elementary School Teacher,” *Electronic Proceedings of the Eighth Annual International Conference on Technology in Collegiate Mathematics*, Editors: Przemyslaw Bogacki, Earl D. Fife, and Larry Husch, 1996.

- [2] Harris, Gary. "The Use of Computer Algebra Systems and Commercial Web Technology in the Undergraduate Mathematics Preparation of School Teachers," *Quaestiones Mathematicae: Journal of the South African Mathematical Society, Supplement no 1*, 2001. 217-226.