Teaching During The Final Exam: How Providing Hints Can Help

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Students Perceptions of an Alternative Testing Method: Hints as an Option for Exam Questions

Introduction

For educators, creating and administering effective evaluation tools can be arduous. Tests and quizzes, the traditional approach, must be challenging enough to assess the student's mastery of course material, yet not so difficult as to frustrate and dishearten. Additionally, instructors must account for the inevitable range of student aptitude in each class. Part of evaluation involves rewarding prepared students with high scores and penalizing neglectful students with low scores. Hence, there is a delicate balance. If an exam is too easy, all students receive high scores and there is no incentive for good students to prepare. Too difficult, even average students will fail.

Evaluating student performance is a complex undertaking, as aptitude is not the only consideration. Factors such as stress can lead to poor scores. Students are often intimidated when asked to compose answers to exam questions. This is especially true for exams requiring detailed technical answers. Low confidence levels and test anxiety can cause a student who knows the material to "draw a blank", unable to recall the exact terms.

Most instructors strive for a negatively skewed unimodal grade distribution, where most student scores cluster toward the high end of the scale. Sadly, bimodal distributions are commonplace because test answers tend to be binary – they are either correct or incorrect. Students who are well prepared answer most questions correctly and receive high scores. Students who are not prepared do not answer correctly and receive low scores. However, what of the students who fall between these two groups? Can students "sort of" know the answer? If the instructor's goal is a negatively skewed unimodal grade distribution, what can be done to increase these students' scores?

Hints for difficult questions can be helpful to overwhelmed students. Sometimes a very subtle bit of information about the correct answer can spark a student's memory, leading to a satisfactory response. However, to be fair to all students, hints must be equitably distributed. Prepared students with no need of help should be rewarded for their efforts. Again, a balance must be struck. Students who will benefit from hints should be able to use them. But this advantage should come at a cost.

In an effort to mitigate this issue, we propose a bartering system that allows students to trade test points for hints that lead to the correct answer. If a student needs help on a test question, he can click a button to receive a hint. This transaction provides the student with supplemental information, but lowers the total points earned for a correct response. While the student stands to earn fewer points, he increases his likelihood of a correct answer.

This approach can help frustrated students to overcome test anxiety by providing an alternative when they are stuck. At the same time, it does not afford any unfair advantages because, in order to obtain a hint, a student must sacrifice some point value. Well-prepared students who do not require help can disregard the barter feature and answer questions correctly while not sacrificing any points. Hence, hints are equitably distributed. Students who use the barter feature can potentially maintain higher scores than they otherwise would, leading to a more uniform grade distribution overall.

Previous Work

Exams are more than a collection of questions. The length of the test, the types of questions and the delivery of the test are crucial factors determining how the exam is perceived. Perhaps the most influential - and controversial - factor in exam administration is the use of supplemental material. Examples involve the utilization of book material or "open-book" exams, or the allowance of a cheat sheet.

The evidence of effectiveness for open-book exams and cheat sheets is mixed. A study by Theophilides and Dionsyious[6] considered anxiety as a factor in whether an exam should be open-book or not. Citing empirical results from multiple studies, they found that open-book exams overall did not lead to an improvement of test scores. However, they do lessen anxiety by reducing the memorization of facts, which allows students to focus on deeper learning. Results from their own study align with these findings. They found that offering open-book exams lowered anxiety and increased optimism when taking the exam. Weber, McBee and Krebs[7] also found that the utilization of open-book testing or the use of a cheat sheet reduced student testing anxiety. Conversely, a study by Dickson and Miller[2] found that students' use of cheat sheets did not decrease testing anxiety.

A study conducted by Gharib, Phillips, and Mathew[5] looked at the overall improvement of test scores and their preference for a specific testing format. A total of 297 students enrolled in an introductory Physiology course and 99 students enrolled in a Statistics course participated. Students were given either the option of an open-book, closed book or cheat sheet for their exam. "Students took a surprise quiz two weeks after the exams to measure retention of course material, completed a preference questionnaire, and took a pre-test measure of test anxiety on open-book and cheat sheet tests." Overall, the researchers saw improved grades for students who took an open-book exam as opposed to a closed-book exam. Students also preferred the open-book exam or cheat sheet as opposed to the closed-book exam.

Do these methods of test delivery lead to deeper learning? Erbe[3] found evidence that allowing students to use a cheat sheet did just that. He concluded that students learn simply by preparing a sheet for use during the exam. Funk and Dickson[4] also conducted a study that investigated the use of cheat sheets. "Students prepared for a later exam by making a crib card but expected that they could not use it during testing. Following the exam, they completed an unexpected posttest

containing identical questions with their crib cards. Performance did not differ." These results indicate that it is not the cheat sheet that leads to higher scores, but the material review that inevitably occurs as students make the cheat sheet.

A study by Block[1] looked at multiple sections of a Math 300 course over three different semesters. In the Fall 2006 semester, students were not allowed to use any supplemental material during exams. In Spring of 2007, open-book exams were offered. In Spring of 2008, students could use notes. At the end of each semester, students were asked to rate the grading techniques and the course as a whole. The overall score of grading techniques was higher for both semesters where supplemental material was allowed. Similar results were found regarding the overall satisfaction of the course. "An emphasis on not relying on the book during exams resulted in higher test scores, but also decreased student enjoyment of the course, as reported in the end of course critiques and by direct feedback to instructors in the course."

Of these studies in which information from the class is allowed during the examination period, results regarding testing anxiety and overall grades are mixed. A confounding factor in each of these examples is that the student's individual preparation - reviewing the text or creating a cheat-sheet - plays an important role in their success. Other methods of content provision that allow the instructor to regulate the dissemination of supplemental materials during testing have not been widely explored. One method to consider is point bartering.

The Point Barter System

In order to evaluate the testing approach described in the introduction, we created an online quiz system called Point Barter. It allows students to take an exam using a web browser. Questions are presented sequentially and the interface is similar to most online testing environments. However, for each question, a barter button is available and is labeled with a predetermined point value (figure 1.).

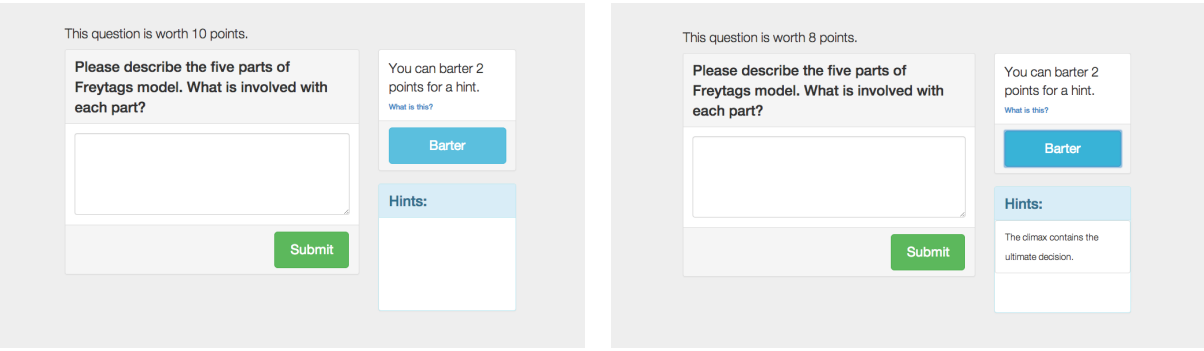

Figure 1. Screenshots before bartering and after bartering.

The student can choose to answer the question with or without using the barter feature. If he does not use the barter feature, the test proceeds like other online tests. However, if he clicks the barter button, the value of the question is lowered by the specified amount and the hint is

displayed. The student can then use the hint to help him answer the question. Questions can have multiple hints, so students can potentially barter multiple times for each question. If the student answers correctly, the adjusted point value is added to their score.

Point Barter is built using the open-source technologies, HTML, CSS, PHP, JavaScript, and MySQL. It works entirely in a web browser and is compatible with all major operating systems and platforms, including mobile devices.

A Pilot Study of Point Barter

We conducted a pilot study using Point Barter for the final exam in a video production class at a midwestern state university in the United States. Twenty-one students participated. Testing occurred in a university classroom computer lab. Students were given the choice to take the exam with or without Point Barter. Those not using Point Barter could use the university's learning management system, which allowed students to answer questions with no hints provided. The test consisted of True/False, Fill-in-the-Blank, Multiple Choice, and Essay questions. At the completion of the test, answers were stored in a password-protected database on a secure server.

The test began with a simple introduction explaining Point Barter and how the barter feature works. After reading the introduction, students proceeded to answer exam questions. After the last exam question, students answered follow-up questions about their experience with Point Barter.

Results

The follow-up questions revealed that 95% of participants would recommend that Point Barter be used in classes (figure 2.). 86% found the Point Barter system easy to use (figure 3.) and 86% prefer Point Barter to traditional online exams.

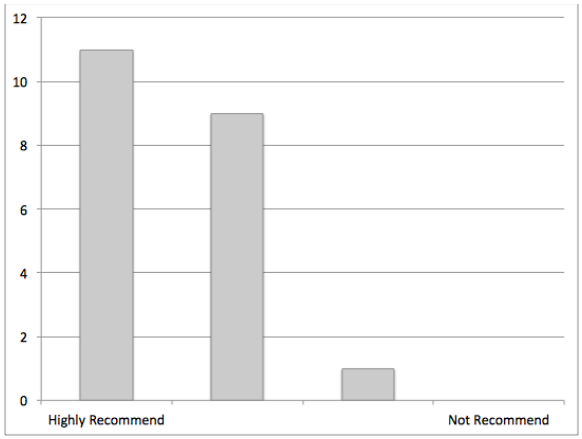

Figure 2. On a scale of 1 - 4 (one being the highest), how likely would you recommend this system in classes?

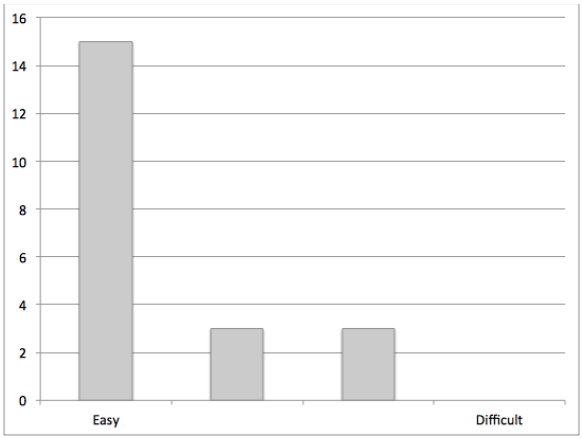

Figure 3. On a scale of 1-4 (one being the highest), how easy was it for you to use the point-bartering system?

The following list summarizes the most commonly submitted remarks when participants were asked to comment on their experience:

- 33% specifically commented that they liked the system.
- 19% would like the option to revisit questions.
- 14% said that the quality of the hints plays a major role in the effectiveness of the system.
- 10% thought the system was easy to understand and intuitive.
- 10% identified that the system is good for sparking memory if the student can't recall an answer.

Discussion

The results indicate that most students who participated in the study had a positive experience with Point Barter. The system and interface seem to be easily understood and easy to use. No students indicated confusion using the barter feature. Its function is straightforward.

Currently, Point Barter is a stand-alone environment that is not integrated into a learning management system. Some comments indicate that students would like the testing environment to function similarly to the testing environment they are used to. For example, several students remarked that they would like the ability to return to previously answered questions and make changes before submitting the exam. One student noted that right clicking was disabled, disallowing him to use the browsers spell-checking feature. We plan to address these issues in the next software revision.

Participants did not find inherent drawbacks with the bartering concept. Bartering is available, but not compulsory. An interesting comment brought up by several students is that the quality of the hints plays a major role in the effectiveness of the system. Indeed, this is similar to the factors affecting any exam; the context of the question, the multiple-choice options, and the question order all affect its level of difficulty.

One participant identified an association between the functionality of Point Barter and a real-world scenario: "When someone has a job and they don't know the answer, they can simply research it." While Point Bartering does not allow unmerited access to supplemental materials, it does offer just-in-time information that mimics the immediate help available through web searches commonly used in most industries.

Since the bartering feature was optional, students perceived it as a lifeline. One participant stated, "While I never actually bartered any points I felt more relaxed throughout the exam knowing that I had that option." The idea of having a hint available seemed to ease testing anxiety. This response is similar to those of students in previous studies that have been allowed to use notes or text books during tests.

Conclusions

The results of this pilot study indicate that Point Barter can enhance the test taking experience. Its user interface is simple and, for the most part, adheres to student expectations. The system helps spark student's memory when taking an exam and students prefer to have the option to barter points for hints. Moreover, having the option to trade point for hints can reduce test anxiety.

While these results are promising, additional work is necessary to determine the effectiveness of Point Barter as an evaluation – and perhaps a pedagogical – tool. The population of this pilot study was relatively small, consisting of a single class and spanning only one exam. Our intention was to "test the test", and was as much an exercise in software quality control as a proof of concept. More studies will be necessary to gather useful data on student perception and usage rates. Likewise, this study did not measure student performance, evaluation of deeper learning, or the effect of this testing method over time. As such, it leaves many questions unanswered and opens the door for further investigation.

Future Work

Moving forward we plan to evaluate Point Barter in the context of different subjects. Teachers of Math, Computer Science, and Humanities may all have different approaches to question structure and hints. Using Point Barter in these contexts may reveal valuable insights.

Additionally, we plan to evaluate Point Barter as a learning tool used throughout the semester. We will examine two sections of the same class – one using Point Barter and the other using conventional testing methods. A comparison of final exam scores and course grades may indicate that using a hint-based evaluation tool actually leads to continued learning as students take tests and quizzes.

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