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Interactive Gradebook: The Missing (Hyper)Link

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1. ABSTRACT

This paper introduces the notion of the "interactive gradebook," a new niche where intelligent and interactive technologies can help educators teach and students learn.

1.1 Keywords

Web-based, education, gradebook, interactivity

2. INTRODUCTION

As we move our classrooms to cyberspace, we find ourselves redefining many of the core concepts in education. Even the fundamental notion of "course" needs to be reexamined. Roger Schank notes that the length of time and amount of material covered in a "course" is completely arbitrary and need not be reflected in Web-based versions [11].

Computer-based testing (CBT) promises to further stretch many traditional concepts, such as "exam'" and "homework." And rightly so. New technologies can release many of our old notions from their past constraints of time and space. This paper introduces the "interactive gradebook," a technological variation on an old theme.

Before examining the idea of an interactive gradebook, let us first consider the very idea of grades, how they are used by teachers and students, a brief look at the history of grading, and finally, grading alternatives.

2.1 Grades & Gradebooks

In a typical course, grades are given to a student for each homework assignment, exam, and project. The giving of the grade marks the end of a section, and the beginning of new material. In this manner, grades are used as a final payment to reward those who have completed their work or learned the material.

Teachers therefore use grades as 'pay' to motivate, and as a 'yardstick' with which to measure their students' performances. Grades aren't really used by the students at all, except possibly for motivation, and for life after college (i.e., getting jobs). However, even grading as a motivation has been questioned.

Gradebooks have traditionally been the personal and private property of the teacher. A gradebook has been, of course, little more than a spreadsheet of scores. However, many technologically savvy instructors now have their gradebooks on-line. There are many good reasons for doing this, the most important one being that students are kept aware (sometimes painfully) of their status in the course. Besides compromising the privacy of the students, on-line gradebooks do allow 24-hour a day access. However, on-line gradebooks have been nothing more than their traditional counterparts.

2.2 History of Grading

The idea of giving grades to students was first introduced at Yale in the 18th century [13]. The idea caught on fairly quickly and by the early 19th century many American universities used some method of grading [2], [7]. Of course, grading is now a well-entrenched part of the education process and most of us could not imagine teaching without it.

However, since nearly the beginning, the concept of grading has had its detractors. In the early 20th century, William Wrinkle condemned the practice of grades as given in exchange for academic performance [16]. More recently, Psychiatrist William Glasser has claimed that failure has never been a good motivating factor for humans [4], [5]. Some viable, if not radical, alternatives have been proposed.

2.3 Grading Alternatives

Nearly 80 years ago, a superintendent of a school system in Illinois proposed and implemented a radical method of recording students' progress. Carleton Washburne replaced the gradebook with a "goal record book" [14], [15]. Washburne described the major difference: "Instead of

giving grades we give dates---the dates on which the children have completed each test in each subject." This methodology has subsequently been termed "charting" alluding to how a doctor might track a patient's progress [7], [8].

Many would agree that charting is much better than most traditional grading systems. It has its price, however. Charting a student's progress requires much time and energy from the teacher. Data must be collected, entered, and analyzed for each student. In addition, each student has their own schedule of progress, so a teacher might find themselves grading a few items everyday rather than intermittently grading large sets of homework and exams. Finally, the entire notion of "semester" breaks down as every student will cover the material in a variable amount of time.

3. INTERACTIVE GRADEBOOK

Our goal is to salvage some of the ideas from charting through the use of an electronic, interactive gradebook. As one might expect, an interactive gradebook provides a method for students to review their past scores. However, of all of the functions, this may turn out to be the least useful to the student. We define an interactive gradebook to have these main functions:

1) Act as a central location for students to *actively explore* their strengths and weaknesses;
2) Help students to understand their performance in relation to others';
3) Motivate them to continue to learn;
4) Suggest further material for them to examine;
5) Provide tools of analysis for teacher and student.

From the students' perspectives, it is the central place for getting feedback and making the most of it. From the teacher's perspective, it is a tool that integrates and facilitates traditional administration with new proactive teaching methods [6].

This tall order would be an impossible task for a simple gradebook system alone. In order to succeed, the interactive gradebook needs to have connections to another key element, namely a computer-based testing (CBT) system.

3.1 The Link to Computer-Based Testing

The idea of computer-based testing has been around for many years. Usually, CBT systems involve multiple-choice questions with automatic grading. However, recently the realm of automatic grading has enlarged to encompass the grading of free-style essays [9].

Carl David [3] has identified many advantages to using CBT. Among them, it:

1) Separates the two roles of the teacher and evaluator which prevents students from feeling betrayed;
2) Provides uniformity in grading;
3) Forces students to directly confront whether or not they actually know the material;
4) Provides a more accurate assessment of learning than standard testing;

For the needs of our interactive gradebook, we are jointly designing a CBT system which we call WebTron (see Figure 1). WebTron is similar to many other on-line testing systems: it has the ability to randomize question order, keep detailed log files, email students using mail-merge, assign grade weightings, perform general administration tasks, protect student privacy, and perform automatic grading to give the student instantaneous feedback with explanations (see Figure 2).

In addition to the standard test-taking and giving functionality, WebTron also allows an instructor to associate a series of "conceptual tags" with each question. For example, the question shown in Figure 1 might be associated with the tags "history", "background information", or more specifically, "Alan Turing." In this manner, the system knows what a question is "about."

When combined with an interactive gradebook, students can get a fine-grained analysis over time of their performance in these key topics. Scores can be calculated and charted to measure accumulated knowledge, as shown at the bottom of Figure 3.

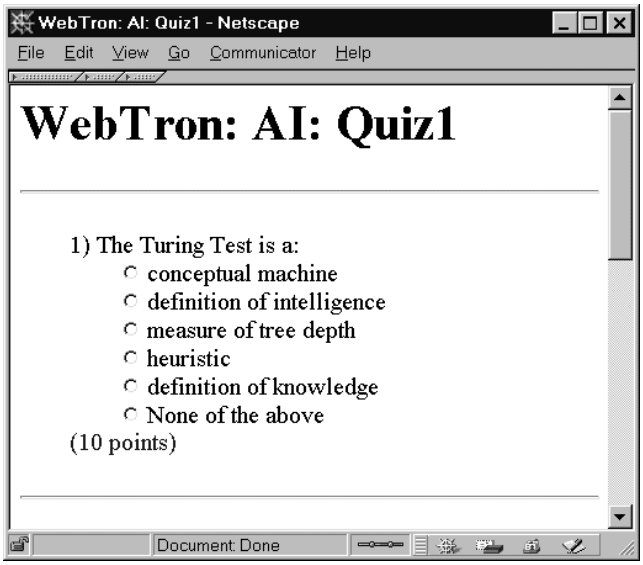

Figure 1. Computer-based testing is a necessary part of the total solution. WebTron, shown here, is our group's on-line exam, quiz, and survey system.

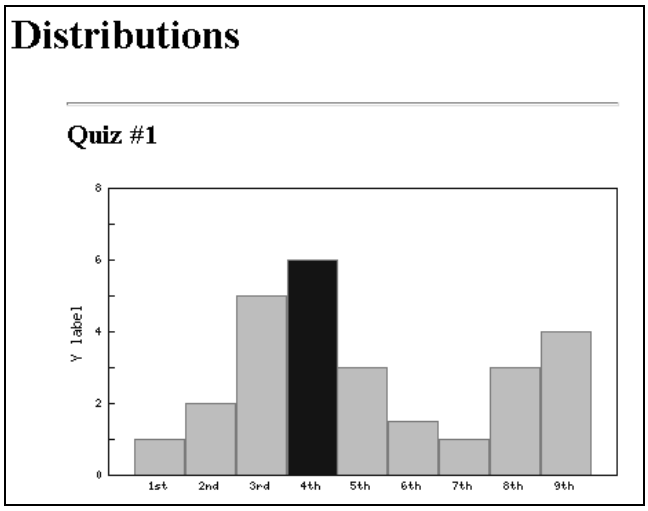

Figure 2. Distribution charts allow students to see how they are doing relative to the rest of the class without sacrificing other's privacy. A student's position is indicated by the dark bar.

4. GOALS & ANAYLSES

Following Washburne's ideology, the key to the gradebook-CBT system is to focus on the goals rather than on the final grade. This is accomplished by presenting the goals of the course in a manner such that students can easily understand and realistically meet. In addition, students are gratified by seeing that there is a direct connection between correctly-answered questions and these goals.

Probably the biggest difference between goal-based and traditional teaching is that items can be resubmitted for re-grading. Rather than being the final measurement, feedback becomes useful to the students as they attempt to learn material they might not have mastered the first time around.

Does this goal-based method of evaluation require abandoning the notion of a semester? Ideally it would, but in reality this will probably never happen. However, we believe that while we must operate inside the rigid boundaries of the semester, the benefits of charting should be taken advantage of wherever possible.

4.1 Collecting Data

Of course, charting is really only a useful concept when there is data to chart. This suggests that there should be ample opportunities for students to exhibit learning. Once test-banks of questions have been built up, there is little additional overhead in giving many quizzes in a gradebook-CBT system.

In addition, we suggest the charts show *progress*. Simply plotting performance would give a flat line for the perfect student. Doing well early on can only produce a sustained flat line or a downward slopping line if the performance is less than perfect later on. How can we collect such developmental data showing a positive sloping line?

One possible method would require asking questions over topics which have not yet been covered. As the semester continued, the students would answer more of these questions correctly, and their chart would show a positive change. Although the logistics of this method could be accommodated (say, by asking experimental questions which were not reflected in a student's score), it might have the effect of demoralizing students. Still, the information gained through such questions could be quite useful.

Another method would be to simply plot accumulated scores for each of the topics charted. This method would show an increasing "level of understanding" (see also [1]). Charting scores in this manner would have the advantage of having rising plots without requiring students to take questions that they should not yet know the answer.

The particular method of charting selected is not as important as its side-effect: the motivation of the student.

4.2 Analysis

A recent study investigated predictors of class performance for students enrolled in two Web-based sections of a course [10]. Analysis revealed that course homepage access was predictive of the students' final grade. Newlin & Wang suggest that instructors should monitor Web-based student activity to identify problem students early on.

Of course simply counting visits to a course homepage is only an indirect predictor. Teachers should also have available a series of reports that show the more direct

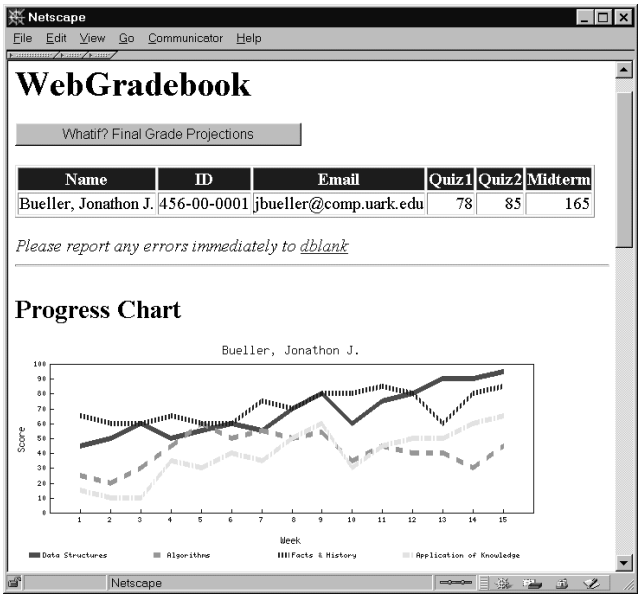

Figure 3. The interface to an interactive gradebook, WebGradebook, developed by the Intelligent & Interactive Tools Research Group at the University of Arkansas.

statistics: quiz scores.

5. ADDITIONAL FUNCTIONALITY

Students are generally very interested in on-line gradebooks, especially near the end of a semester. At that time, many instructors are inundated with questions similar to "What do I need to get on the final to get a C in the course?" To address these questions, we have included a "What If?" calculator in our version of the interactive gradebook. Whether or not this can act as a motivator early in the semester is not yet know. It does relieve the instructor from having to answer these question, however.

One of the most helpful functions of the interactive gradebook that we have imagined is the ability to suggest (or create) practice quizzes. If a student is doing poorly in a given area, the system might suggest a series of quizzes on that topic. Along similar lines, we have designed an interactive game (written in Java) that allows students to play against each other. In this manner, our gradebook could integrate a third application: the on-line tutoring system.

6. FUTURE WORK

Creating a test-bank of quiz and exam questions is still a time consuming process. For this reason, we expect that instructors would be very interested in being able to share questions. To that end, we hope to develop a standard format for sharing questions between implementations of CBT systems (see Figure 4).

After running an interactive gradebook in association with a CBT system for a number of semesters, a large set of statistics would accumulate. What useful function might that data be used for? One idea that we have discussed is to cluster past data in an attempt to correlate current students' scores with past students' final performance. If this turns out to be correlated, then we might be able to identify problem students early in the semester.

Currently, teachers must manually create questions and tag them with their relevant concepts. A system could be designed to automatically calculate what a question was "about." Similar methods have been used to grade essays [12].

7. CONCLUSION

We believe that computer-based testing system has missing links without an intelligent, interactive method for students to explore and connect what they have learned to what they have not.

The future cyber-classroom will, of course, never replace the physical classroom. On the other hand, technology can make practical that which might have otherwise remained idealistic. We believe that the idea of an interactive gradebook can help make the useful concept of charting a virtual reality.

```
@question{ai1998-34,
    area=”Computer Science”,
    topic=”Artificial Intelligence”,
    level=1,
    concept1=”Alan Turing”,
    concept2=”background knowledge”,
    concept3=”history”,
    type=”multiple choice”,
    question=”The Turing Test is a:”,
    option1=”conceptual machine”,
    option2=”definition of intelligence”,
    option3=”measure of tree depth”,
    option4=”heuristic”,
    option5=”definition of knowledge”,
    explain=”The Turing Test is a working
    definition of intelligence”,
    score=3,
    author="Blank, D.S.",
    img=none,
    randomize=1,
    none-above=1,
    date=”1998-09-10”,
    url="http://csci.uark.edu/"
}
```

Figure 4. A Bib-TeX like format for exchanging questions between interactive gradebook-CBT systems.

8. ACKNOWLEDGMENTS

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