GAMING IN MIDDLE SCHOOLS

An Interactive Qualifying Project Report

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By

Ricardo A. Belmontes

Samantha J. Fontaine

Ryan J. Genato

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Professor Ryan S. Baker, Major Advisor

Abstract

Research has shown that when presented with an intelligent tutoring system, many students engage in gamingthe system —"exploiting properties in the system rather than by learning the material and trying to use that knowledge to answer correctly [1].In this paper, we replicate a study that originally introduced "a system which gives a gaming student supplementary exercises focused on exactly the material the student bypassed by gaming, and which also expresses negative emotion to gaming students through an animated agent" [1]. This study was conducted at a middle school in the United States who had previously never been exposed to an intelligent cognitive tutor system. The purpose was to determine whether American students who had never used an intelligent cognitive tutor would game, and if those engaged in gaming would learn less than those who did not. Baker, et al. have found previously that American students who have prior experience with this kind of software exhibit this phenomenon [2,3].The system has shown to increase the learning in students who have the cognitive tutor over those who do not, and those who game learn less than those who do not.

Introduction

With the increase in use of computers in the classroom, much attention has been brought to the way in which students interact with intelligent tutoring systems. The research by Baker, et al. [2,3]has shown that exploiting properties in the tutoring systems, or gaming, has been associated with poorer test results. The acts of systematic guessing and brute force answer submission have been shown to arise from two separate circumstances: either the student does not know the material and attempts to game in order to progress, or games on problem steps the student already knows, and is not associated with poor learning outcomes [1].

In this paper we will present our experiences with using the cognitive tutor that responds to the gaming where a student does not know the material, or "harmful" gaming [2] Named Scooter the Tutor,

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Scooter keeps track of students' actions and interacts with the students when they game[1].When a student games Scooter becomes animated, growing more unhappy as the student games. Scootergives supplementary exercises on the exact steps of the problem-solving process that the student gamed [1].

Background

The same study has been conducted several times before in two schools in the United States[1] as well as other countries like the Philippines, Mexico, and Costa Rica [4,5]. In the United States and Philippines, the intelligent tutor system has been highly successful at improving the learning outcomes of students who are at risk of gaming or who already game.

The intelligent tutor system uses interactions with Scooter the Tutor (shown below). Scooter the Tutor was created for two different purposes. The main purpose was to reduce the incentive to game and secondly help students learn the material that they tried to avoid by gaming. Though these goals set out to help out students who game they also must affect non-gaming students as little as possible.

Scooter is a persistent reminder to students not to game and expresses normal social behavior like anger when a student tries to game the system. Scooter will give the student who games a second chance through supplementary exercises. These exercises will help the student learn the material and teaches the student that trying to game the system is a waste of time and therefore results in extra exercises. The overall outcome will be that students won't need to game because the students now knows the material and will not want to work on additional problems.

You know how to use the tutor right!

Figure 1: Scooter the Tutor happy when students aren't gaming

Work carefully, so you can learn.

Figure 2: Scooter the Tutor angry when students are gaming

Why do we need to know the largest value of height in this part of the problem?

☐ To help pick a scale for the axis
☐ To help pick the last label of the axis
☐ To help pick the first label of the axis
☐ To help pick which point to plot first

Figure 3: Scooter the Tutor giving supplement exercise to a gaming student

Methodology

We studied the effectiveness of Scooter as an active, educational response to gaming in an urban middle school setting at Mary E. Wells Middle School in Southbridge, Massachusetts. Previous research in the United States involved students who had already used similar software for several months. Research in the Phillippines, Mexico,and Costa Rica involved students who never seen similar software. This is confounding because it is not clear whether the difference between countries was due to cultural differences or their experience with this kind of software. Mary E. Wells has never used this kind of software, eliminating this confound.

We started off with a sample size of 190 students which consisted of all the seventh and eighth graders at Mary Wells but our final sample size was reduced to 139 students due to absences. The study was spread out into a one week timespan at the latter end of the spring semester.

The study was broken down into four categories which consisted of an instructional presentation, pre-test, tutor and post-test, in that order. In addition to these, a pre-questionnaire was given before the tutor and a post-questionnaire was given after, that assessed students' views on Scooter and the tutor system. The instructional presentation was aPowerPoint presentation that was delivered by the teacher that covered all necessary conceptual background about scatter plots for students to learn from the tutor [6].For most of the students, this was the first time being exposed to this particular topic but it was relevant to the mathematics curriculum because it was an area that was tested on for the Massachusetts Comprehensive Assessment System (MCAS). The MCAS is a standardized test needed to graduate high school in the state of Massachusetts. The duration of the instruction was 30 minutes and it was followed by a pre-test. The pre- test was an assessment of a scatter plot that the student was required to plot using the information provided in the allotted 25 minutes. On the second day students then moved onto the intelligent tutoring software on the computers that lasted for 80 minutes which was split into two days. Each student was randomly assigned either a control or experimental version of the software. The only difference was that the experimental version had Scooter the Tutor which helped prevent gaming. The software intended to teach students how to interpret data and create a scatter plot to present the data. On the last day, the students were given a post-test that was used to assess their gains from thetutor. To prevent bias from either the pre-test or post-test being more difficult than the other we used two previously created scatter plot tests from Baker [1], and referred to them asForm A and Form B. One group of 40 students was assigned Form B for the pre-test and the rest of students were assigned Form A. For the post-test we simply switched the order and assigned the students who had gotten Form A for the pre-test Form

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Band vice versa. It should be noted that due to experimental error we did not distribute the two versions of the forms 1:1 but instead had a 1:3 ratio of Form B to Form A.Finally, log files were used to distill measures of Scooter's interactions with each student and the frequency with which Scooter gave a student supplementary exercises.

Results

There was a 14 point gain in the overall average (63% -> 77%) (See Fig 4) and a significant increase in test scores, t= 3.89 and p= 0.0002, which supports the hypothesis and prior results that the software does enhance learning.
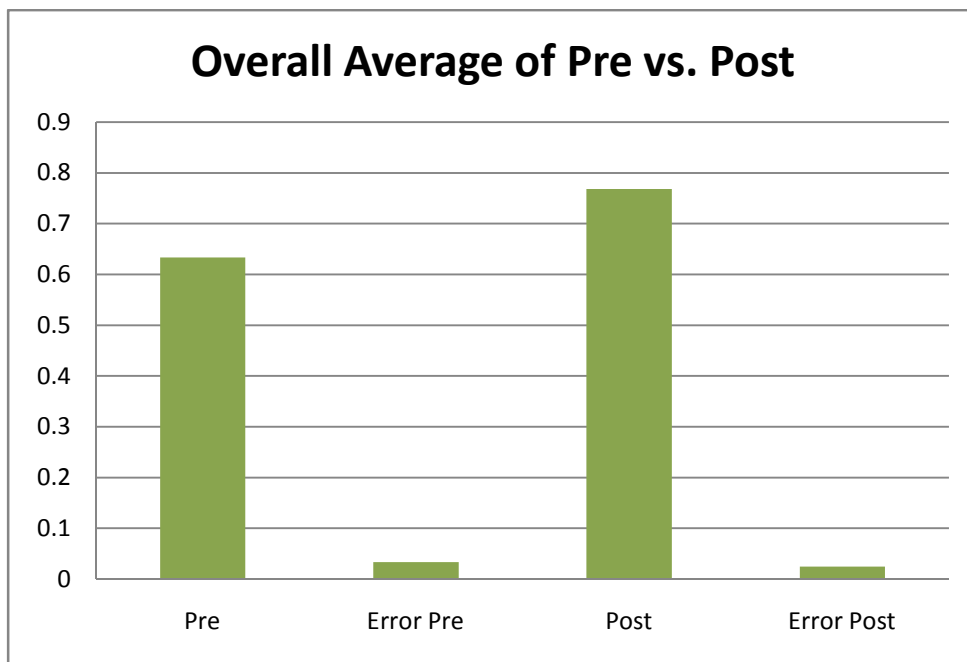

Figure 4

A more in depth analysis of the data shows that there was an 8 point gain in the control group and a 17 point gain in the experimental group (See Table 1) which may be due to the supplementary exercises provided by Scooter. This is not a statistically significant difference, t=1.02 and

p=.30.However, this improvement of the pre to post-test by experimental and control does not tell us whether Scooter helped the students who were gaming.

Condition	Pre-Test Average	Post-Test Average
Control	68%	76%
Experimental	60%	77%

Table

In order to evaluate whether the interventions by Scooter were associated with increased learning gains, the data of students was split into three groups(approximately a third per group) – high levels of Scooter interaction (more than six interventions), medium levels of interaction (between two and four), and low (one and zero interventions) levels of interaction. Their gains from pre to post-test were evaluated (Fig 5).
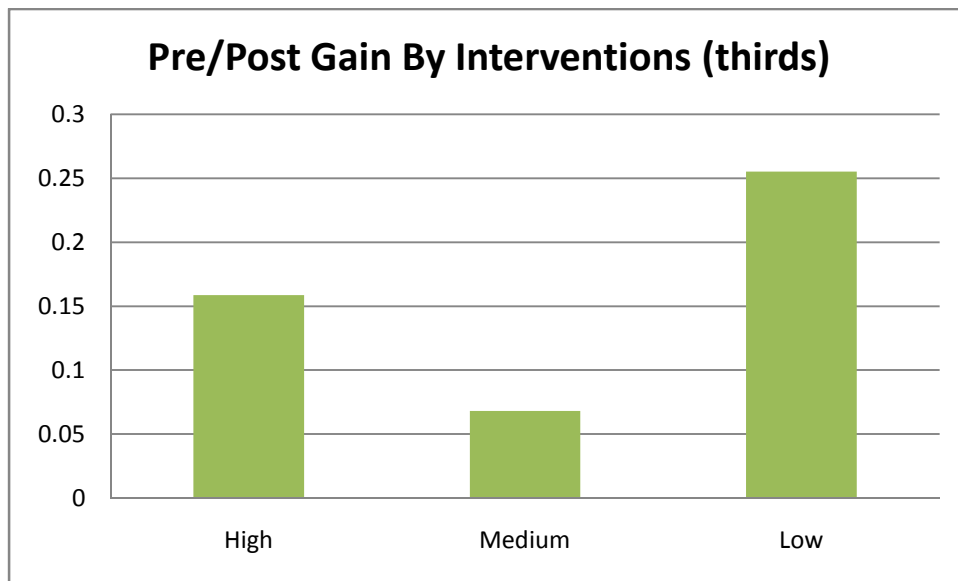

Figure 5

Based on the results, the students who engaged in a low level of gaming, or did not game at all improved the most between the pre-test and post-test. This supports the findings by Baker, et al [2,3],

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that gaming is associated with poorer learning. However this is not statistically significant, t=.93 and p=.36. What is also noteworthy is that the students who received a high (six to twelve) amount of supplementary exercises had more significant gains than the students who received only a medium amount (two to four) of exercises from Scooter. This is statistically significant, t=1.72 and p=.09.

Conclusions

In this paper, we analyze an intelligent tutoring system that detects the act of gaming and use our results to determine whether an intelligent tutor that responds negatively to gaming and offers supplementary exercises is conducive to higher learning rates. The results show that the students who have the fewest interventions by Scooter have the greatest increase in learning. The overall scores indicate that each group of students who had Scooter had larger improvements on their post-tests than the students who did not. This matches the previous findings by Baker, et al. [2,3], where students in American schools who had previous experience with intelligent tutoring systems experienced similar results. Our findings indicate that whether a school has never seen an intelligent tutoring system before has no bearing on the performance of the students, between those who game and those who do not.

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