Competitive Learning: Can Computer Games Increase Student Achievement?
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Association of School Business Officials International
National Association of Elementary School Principals
National Association of Secondary School Principals
National School Public Relations Association

ERS Executive Staff:
John C. Draper, Ed.D., Chief Executive Officer
Katherine A. Behrens, Chief Operating Officer

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Executive Summary

Can educators use students’ natural love of video games to increase student achievement? In a multiyear study of Alabama schools using a Web-based, standards-aligned, game-driven program targeting math and reading skills and built on the K-8 state curriculum, comparisons between 20 Kids’ College schools and 20 demographically similar control schools showed a statistically significant increase on the annual state assessment scaled scores in math. While not statistically significant in reading, the data show a trend for increased student achievement as demonstrated on the annual state assessment scaled scores.

Report on the Effectiveness of the Alabama Kids College Program

Kids love video games. We all know it—and many educators consider video games a detriment to learning. But this study paints a different picture. Since 2007, more than 100 Alabama schools have used a program called Kids College (KC) that connects learning and video games in a novel fashion. The program targets K-8 students needing skills practice or remediation in math and reading. The curriculum includes more than 40,000 skills assessment items covering 3,700 skills strands. Each item was aligned to Alabama standards in math and reading for grades K-8. The program attempts to use a student’s desire to play video games as motivation to learn math and reading.

In the KC program, video games such as soccer, snowboarding, and volleyball are accessible for limited play only after a student successfully answers a set of subject-matter questions. After a minute or so of play (time controlled by the teacher), the student must answer another, more difficult set of 10 questions to continue play. If the student fails to answer the questions correctly, he must try again and be successful to unlock the game. The program can be set for a specific subject and grade level or it can be
set to automatically adjust as a student progresses. This adaptive feature allows each student to experience a “win” and encourages continued use of the program. This engages the motivational psychology of infrequent rewards to impact each student and encourages student learning to earn more playing time. Since the program is delivered on the Web, students can—when allowed by the teacher—continue using it after hours and even from home. Students can compete with one another, in groups, or with the entire class. The adaptive feature of the program allows students of lower ability levels to compete effectively with those of higher ability levels. It essentially provides an automatic leveling of the playing field so that all students can progress at individual rates and still engage in the competition. It rewards effort, growth, and persistence.

Each student’s progress is recorded and available to the teacher in a student profile showing mastery of specific competencies and areas needing improvement. In addition, the teacher can review a class profile, combining the progress of all students into a simple color-coded graph listing competencies as mastered (green), partial mastery (yellow), or needs improvement (red). The school principal receives a school report showing all students’ mastery of specific competencies, sorted by grade and/or teacher. It is a big picture of student body progress that allows faculty and administration to assess the needs of the entire school.

Methodology

In this study, 20 schools with the highest student participation rates in the KC program were matched with 20 demographically similar control schools. The criteria for matching the KC and control school pairs included grades served, enrollment, percentage of free/reduced-price lunch students, community median household income, and community poverty index. Every effort was made to compare schools from similar communities with similar characteristics. Data analysis compared the KC schools with the control group schools using schoolwide and grade average scores on the annual Alabama Reading and Math Test (ARMT), which is a criterion-referenced test. It consists of selected items from the Stanford Achievement Test (Stanford 10) that match the Alabama state content standards in reading and mathematics. Additional test items were developed to be included so that all content standards were fully covered. It is this combination of Stanford 10 items and newly developed items that is known as the ARMT. The ARMT has a 100% alignment to the Alabama state content standards in reading and mathematics.

A student must complete the Stanford 10 Word Study Skills (Grade 3 only), Stanford 10 Reading Vocabulary (Grades 3-8), Stanford 10 Reading Comprehension (Grades 3-8), and the ARMT Part 2 Reading subtest to get an ARMT reading score. A student must take Stanford 10 Mathematics Procedures (Grades 3-8), Mathematics Problem Solving (Grades 3-8), and the ARMT Part 2 Mathematics subtest to get an ARMT mathematics score.
Data Collection and Analysis

The data consist of average reading and math scores as reported on the Alabama Reading Math Test (ARMT), part of the annual state testing program, for the various grade levels at the 20 KC schools and at the 20 sister schools selected as the control group. The data reported are average scores at each grade level in the school and numbers of students tested for 2007, 2008, and 2009. Most of the KC schools (17) started the KC program in 2008, so the 2007 data represent a baseline measurement. Three of the schools started the KC program in 2009, so the 2008 data represents a baseline measurement for them and their matched control schools.

Given the structure of the data, there are several approaches that can be used for analysis. The outcome variables of interest are differences between reading and math scores in the baseline year (2007 or 2008) and after one year of the KC program (2008 or 2009) for those schools participating in the KC program and the control group. The outcome variable could be measured as an average score at the grade level or at the school level.

One issue in measuring improvement is whether to compare within a cohort of students (e.g., compare scores for the 5th-graders at a particular school in 2009 to their scores in 2008 as 4th-graders) or to compare at the same grade level (e.g., compare 2009 4th graders to 2008 4th-graders at a particular school). We elected to follow the latter approach, which is similar to what is done by the state. A second issue is whether to compare data at the grade level or at the school level. Finally, there is the choice of using either a matched samples analysis or an independent samples analysis. If the quality of the matches is good, then a matched samples analysis often performs better in detecting differences.

Grade-Level Analysis

We start by treating the grade-level data as independent samples from the KC and control populations and performing a two-sample test of the difference in mean improvements in ARMT scores, first in reading, then in math. There are 67 grade-level averages for the KC group and 66 grade-level averages for the control group. The graph below is a boxplot of the average reading improvements (ReadImprove) and the average math improvements (MathImprove) at the grade level for the KC and control groups. The differences in average reading improvements for the KC and control schools show progress at the expected levels, trending higher for the KC schools. The average math improvement at the grade level for the control schools is as expected, but the KC schools clearly show math improvement higher than the control schools.

Two-sample tests, based on an assumption of independent samples, are shown in the output below to verify what we observed in the graph above. In the first test, while the difference in average reading improvements is positive (0.75), the difference is not significantly different from zero (p-value = 0.243). On the other hand, the difference in average math improvements (2.85) is statistically significant at the 5% level (p-value = 0.032).
Two-Sample T-Test and CI: ReadImprove, Group

Two-sample T for ReadImprove
Group N Mean StDev SE Mean
KC 67 0.39 6.08 0.74
Control 66 -0.37 6.36 0.78
Difference = mu (KC) - mu (Control)
Estimate for difference: 0.75
95% lower bound for difference: -1.03
T-Test of difference = 0 (vs >): T-Value = 0.70 P-Value = 0.243 DF = 130

Two-Sample T-Test and CI: MathImprove, Group

Two-sample T for MathImprove
Group N Mean StDev SE Mean
KC 67 2.82 8.07 0.99
Control 66 -0.03 9.48 1.2
Difference = mu (KC) - mu (Control)
Estimate for difference: 2.85
95% lower bound for difference: 0.32
T-Test of difference = 0 (vs >): T-Value = 1.86 P-Value = 0.032 DF = 127
School-Level Analysis

We then treated the school-level data as matched samples from the KC and control populations and performed a paired samples test of the difference in mean improvements in ARMT scores, first in reading, then in math. The graph below is a boxplot of the paired differences in average reading improvements) at the school level. From the visual evidence, the average difference in reading improvements at the school level shows some improvement and the average difference at the school level in math improvements is even greater.

Paired samples tests are shown in the output below to verify what we observed in the graph above. In the first test on the difference in reading improvements, the difference (0.69) is not significantly different from zero (p-value = 0.292). On the other hand, the difference in average math improvements (2.57) is statistically significant at the 5% level (p-value = 0.022).

**Paired T-Test and CI: AvgReadImprove_KC, AvgReadImprove_Control**

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<thead>
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<tr>
<td>N Mean StDev SE Mean</td>
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<tr>
<td>AvgReadImprove_KC 20 0.270 3.315 0.741</td>
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<td>Difference 20 0.69 5.53 1.24</td>
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<td>T-Test of mean difference = 0 (vs &gt; 0): T-Value = 0.56 P-Value = 0.292</td>
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Paired T-Test and CI: AvgMathImprove_KC, AvgMathImprove_Control

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95% lower bound for mean difference: 0.50

T-Test of mean difference = 0 (vs > 0): T-Value = 2.15 P-Value = 0.022

User Reviews

The KC program is designed to assist with the challenge of differentiating instruction. It provides a state-aligned assessment, automatically ‘grades’ the assessment, modifies the curriculum based on the results, and then presents a new assessment at the target level for the student. After assessment, the KC reporting system provides a quick picture of each student’s skills assessment. The system automatically scaffolds the curriculum to reach students who are below grade level and provides material suitable for struggling students.

The program design undoubtedly contributes to its effectiveness, but the overwhelming driver of increased student achievement may well be the motivation of the video games integrated into the process. Interviews with students and teachers point to the capacity of the program to motivate—especially those students who often fail to respond to ‘traditional’ methods of motivation.

Teachers from multiple grade levels were interviewed to get their perception of the KC program. A 4th-grade teacher shared, “My students enjoy competing against each other.” A 2nd-grade teacher explains, “They love to play to earn points and are very proud when the get the certificates and rewards at the end of the nine weeks.”

Other comments included:

- “I love the games because they motivate the children.”
- “It has strengthened some of my students in math because of the repetition and practice they get.”
- “My students cannot wait until it is their turn on the computer rotation.”

One criticism shared by a kindergarten teacher was “It’s difficult for my struggling kindergarteners,” and that “advanced students are more motivated to use Kid’s College at home to win a certificate.” A 4th-grade teacher explains that KC has made a difference in math and reading for some of her students, but not all.

Four principals representing both urban and rural schools were asked about KC. All four reported that their students used KC at home. One urban principal shared,

Our students use it in our after-school program. We send home user information for the parents. We have student-led parent conferences and many of our students use KC data as they talk about their own progress.
When students were asked why they used KC, their responses divided almost evenly between “I want to learn more,” “I want to get the high score in my favorite sport,” and “It’s fun.” While “Playing the games” was cited most frequently as the students’ favorite part of KC, several chose the “Hints that help me understand why I got a question wrong” as their favorite part of the program. Some of those same students shared that one of their favorite parts of the program was “It tells me, ‘correct!’ when I get the right answer.”

**Research Summary**

In a multiyear study of Alabama schools using a Web-based, standards-aligned, game-driven program targeting math and reading skills and built on the K-8 state curriculum, multiple data comparisons were made between 20 KC schools and 20 demographically similar control schools. The data consist of average reading and math scores as reported on the Alabama Reading Math Test (ARMT), part of the annual state testing program, for the various grade levels at the 20 KC schools and at the 20 sister schools selected as the control group. The data reported are average scores at each grade level in the school and numbers of students tested for 2007, 2008, and 2009. Most of the KC schools (17) started the KC program in 2008, so the 2007 data represent a baseline measurement. Three of the schools started the KC program in 2009, so the 2008 data represents a baseline measurement for them and their matched control schools.

**Reading Analysis**

The ARMT scores in reading at the KC schools, when compared to the control schools utilizing grade level and school level comparisons, show a trend supporting the positive impact of the KC program on student scores (but do not meet the test of statistical significance at 5% level). The trend is more evident when matched samples of demographically similar KC and control schools are used for the analysis.

**Math Analysis**

The ARMT scores in math at the KC schools, when compared to the control schools utilizing grade level comparisons, show a positive difference in average math improvements (2.85) that is statistically significant at the 5% level (p-value = 0.032). In addition, when matched samples of demographically similar KC and control schools are used for analysis, the difference in average math improvements (2.57) is also statistically significant at the 5% level (p-value = 0.022). There is statistically significant evidence utilizing both methods of analysis, that participation in the Alabama Kids College program results in higher average math scores on the ARMT.