Sokikom Research Study

Spectrum Elementary School, Gilbert, AZ

Sokikom

Contents

Introduction

Sokikom motivates elementary students in a math social learning game. Developed for grades 1-6, Sokikom emphasizes real-time cooperation and collaboration to engage students in developing math skills and in helping each other learn math. Massively multiplayer online game features combine with NCTM curriculum focal points and Common Core State Standards to provide intense engagement and higher math achievement.

Initially funded through SBIR grants from the Institute of Education Sciences (IES), a research entity within the U.S. Department of Education, Sokikom has designed its games using the principles of guided, discovery-based, social, and situated learning. The guided discovery learning theory uses inquiry-based learning where the learner draws on his or her past experiences to discover facts and relationships in new domains. Students interact in the new domain by freely exploring and experimenting to develop a better sense of the rules. As a result, students may be more likely to remember concepts and knowledge discovered on their own (Bruner, 1961).

The situated and social learning theories posit that learning is embedded within activity and presented in meaningful contexts through relevant applications. Social interaction and collaboration are essential components of learning (Lave & Wenger, 1991). Furthermore, recent research documents that social and intellectual support from peers and teachers is associated with higher mathematics performance for all students (NMAP, 2008). Games enable students to have immersive learning experiences that can't be accomplished in non-gaming environments (Shaffer, 2005). Sokikom provides students with the opportunity to experience social learning, where they apply math skills in an interactive multiplayer environment.

There is a substantial body of growing research to support the hypothesis that games can improve both student performance to math standards and student motivation to learn math (Kebritchi, 2010; Lopez-Morteo, 2007; Eck, 2006; Prensky, 2001). This empirical research includes meta-analysis of the instructional effectiveness of games compared to conventional classroom instruction. This research has consistently found that games promote learning across multiple disciplines and ages. Research also shows that playing educational video games improves student motivation to learn mathematics (Rosas, 2002). Improved student motivation to learn math has been further shown to result in improved mathematical performance (Viljaranta, 2008, Cordova, 1996; Gottfried, 1990).

Research Questions

The purpose of this study is to investigate the impact of implementing a web-based math learning game into classroom math instruction for students in grades 2, 3, and 4. Of major interest to this study is the impact of the intervention, i.e. Sokikom math learning game on learning outcomes.

The major research questions being addressed in this study are:

- *What effect does Sokikom have on learning outcomes?*
- *What are the differences, if any, between conditions with respect to grade levels?*

It is hypothesized that the benefits of engagement inherent to video game environments along with the learning benefits behind guided discovery and experiential learning will have an effect on student math learning outcomes.

Sample

A study was conducted in the spring of 2010 in order to investigate this hypothesis. Six classrooms participated in the study. Two classrooms from second, third, and fourth grade. Altogether, there were 125 participants in this study. Out of those, 115 completed the entire study. The participants were enrolled in grades 2, 3, and 4 at Spectrum Elementary School located in Gilbert, Arizona. This grade range was selected because students are introduced-to, and learning, fractions during these years.

Measures

Student learning outcomes were measured using an online mathematics standards test designed to assess students' fractional knowledge.

Mathematics standards

Student performance in the fraction specific math standards covered in Frachine will be tested using a math standards test developed by Sokikom. The questions in this test are similar to those found in the Arizona Instrument To Measure Standards (AIMS). All questions on the AIMS are evaluated by committees of content experts to ensure their appropriateness for measuring standards and fairness to gender, ethnicity, and language. Our team has found these questions to be similar to corresponding tests in several other states including California, Texas, and Florida. Questions were further reviewed by teachers and curriculum staff from the pilot study school. Link: http://www.quia.com/quiz/1892880.html

Procedure

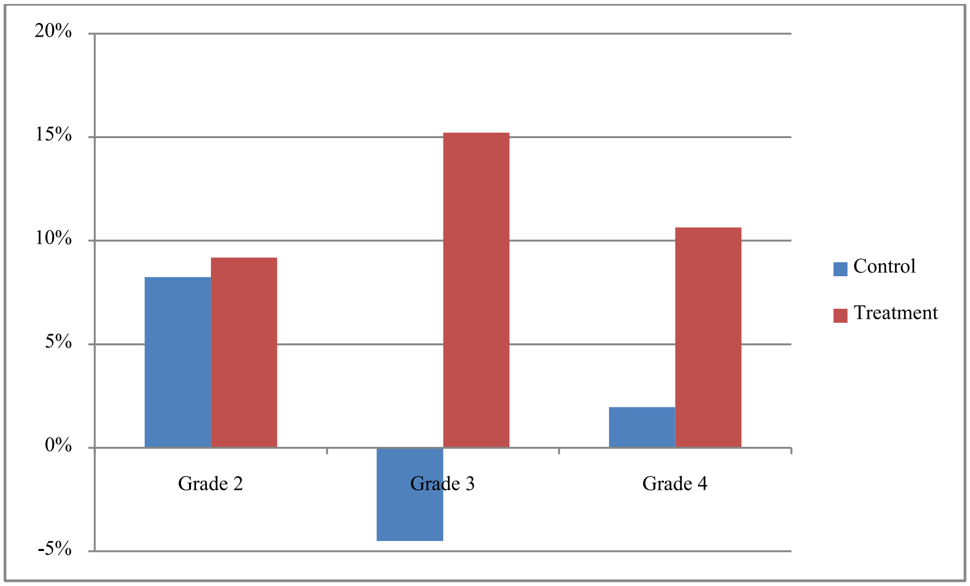
Students will be playing a web-based game, Frachine, that teaches fractions. Frachine uses Constructivist learning theory techniques to teach and give practice in Fraction concepts for elementary students. The purpose of this study is to determine the impact of implementing Frachine into classroom math instruction via a hybrid model of using a portion of the total instruction time for regular math instruction and another portion for practice using Frachine. Students were separated into two groups. One of these groups implemented Frachine during a portion of their classroom math instruction time. The second group received their normal math instruction during the entire period.

Study

Our team worked with teachers from the school prior to the study, to familiarize them with the game and study procedures. Students were given parent permission forms to participate in the study. The pilot study involved six classrooms, n = 135, from grades 2, 3, and 4. There were two classes from each grade level. Three of the classes (one class from each grade level) were randomly selected to serve as the treatment group and implement Frachine during a portion of their classroom math instruction time. The remaining three classes served as the control group and received their normal math instruction during the entire period. The treatment group played the fraction learning game for 5 days, 20 minutes per day in addition to their teacher-led math instruction while the control group proceeded with regular classroom instruction without playing the game. None of the groups received classroom instruction in fractions during the study. The material they learned in math was in areas other than fractions. Teachers were specifically given instructions not to teach fractions during this period as to determine what the impact of using Sokikom would be independent of teacher instruction focused on the same topics.

We started day one of the study by administering a summative pre-test for all students using the math instrument described earlier. During the experiment, we collected observational and self-report data from students to assess implementation fidelity for student engagement and usability. Observational and self-report data was also collected from the teacher to determine how easy both interventions were to use and incorporate into classroom practice. Our servers have stored the amount of time that students spent on the game in and out of the classroom. On the last day of the study, all students were given a summative post-test using the math instrument from the pre-test. Results of both groups were analyzed for effects on student outcomes using multiple paired samples T-test.

Pre-to-Post Test Changes, Control and Treatment Groups



Analysis

Notably, on average, students in the treatment condition improved their performance more from pre-test to post-test (*M* = 1.97, *SD* = 2.35) those in the control condition (*M* = .29, *SD* = 2.13). In the present study, the null hypothesis is students' learning gains in the treatment group (those who played Frachine) would be no different than learning gains of students in the control group (those who did not play the game). Students in the treatment group scored an average of 7.89 (SD=2.94) on the pre-test and their counterparts in control group scored an average of 8.90 (SD = 3.57). For all tests in this study, we used an alpha level of .05, and at this level, the *t*-test of independent samples ($t(123)=1.73$, $p=0.95$) allows us to accept the null hypothesis that there is no statistically significant difference between each group's performance on the pre-test. On average, students in the treatment condition scored higher (*M* = 9.68, *SD* =3.15) on the post-test than those in the control condition (*M* = 9.05, *SD* = 3.72). However, the *t*-test of independent samples ($t(114)=0.98$, $p=.16$) requires us to accept null hypothesis that the there was also no statistically significant difference between these group's performance on the post-test. The *t*-test of independent samples in this case allows us to reject the null hypothesis that there is no significant difference in each group's improvement ($t(113)=4.00$, $p < .01$).

	Control		**Treatment**		
	M	SD	M	SD	*t*-test
Pre-test	7.89	2.94	8.90	3.57	ns
Post-test	9.68	3.15	9.05	3.72	ns
Change	1.97	2.35	.29	2.13	-4.00***

***p<.001

We conducted an additional set of independent-samples *t*-tests to determine whether the null hypothesis, students in the treatment group performed no differently than those in control group, was true in each grade. In second grade, we accepted the null hypothesis for the pre-test ($t(30)=1.64$, $p=.06$), and the change in scores, ($t(29)=-.23$, $p=.41$), so there was no significant difference between their performance. However, on average, students in the treatment condition outperformed ($M=7.25$, $SD=5.67$) their counterparts in the control group ($M=5.67$, $SD=2.38$) on the post-test.

In third grade, we accepted the null hypothesis for the pre-test ($t(36)=.91$, $p=.8$). However, on average, students in the treatment condition outgrew ($M=2.59$, $SD=2.92$) their counterparts in the control condition ($M=-.76$, $SD=1.56$; $t(32)=-4.17$, $p<.001$). Additionally, students in the treatment condition performed better on the post-test ($M=10.41$, $SD=3.71$) than their counterparts in the control group ($M=7.82$, $SD=2.58$) on the post-test, and we found this difference in post-test scores to be significant ($t(32)=-2.36$, $p<.05$).

In fourth grade, we found no significant difference between students' performance on the pre-test and post-test between the control and treatment groups. However, we found that students in the treatment condition experienced more growth by the post-test ($M= 1.80$, $SD=2.15$) than their counterparts in the control group ($M=.33$, $SD=2.33$), and we found this difference in post-test scores to be significant ($t(48)=-2.32$, $p<.05$).

	Grade 2				
	Control		Treatment		
	M	SD	M	SD	*t*-test
Pre-test	4.73	1.39	5.82	2.215	ns
Post-test	5.67	2.38	7.25	1.84	-2.0781*
Change	1.40	1.88	1.56	2.00	ns
*$p<.05$					

	Grade 3				
	Control		Treatment		
	M	SD	M	SD	*t*-test
Pre-test	8.71	2.51	7.82	3.47	ns
Post-test	7.82	2.58	10.41	3.71	-2.36*
Change	-.76	1.56	2.59	2.92	-4.18***
*$p<.05$, ***$p<.001$					

	Grade 4				
	Control		Treatment		
	M	SD	M	SD	*t*-test
Pre-test	11.56	2.68	9.1	2.34	ns
Post-test	12.04	2.69	10.67	2.66	ns
Change	.33	2.33	1.81	2.15	-2.32*
*$p<.05$					

Conclusion

Interestingly, we noticed that in all grades that participated in this study, the treatment groups outperformed the control groups in terms of the amount of growth from pre-test to post-test. Although our findings revealed that the data was not statistically significant across all grades, the changes experienced by the treatment groups in the 3rd and 4th grade were statistically significant. In conclusion, this data shows initial promise of the Sokikom fraction learning game in improving student achievement. However, additional studies are needed, specifically those involving larger samples of students using Sokikom for longer periods of time. In addition, it would be valuable to understand how the Sokikom program impacts specific student populations and further evaluation on the impact for different grades.

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