**Increase Math Performance for a Seventh Grade Math Support Class using Math Video
Games**

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**Abstract**

The  research looks at  how effective is math practice using video gaming on the star math results of a seventh-grade math support class. The participants are eighteen seventh grade general education math students, ten male and eight female, enrolled in the California public school system, who attend a weekly after school math support class. The research is using  quantitative measures based on two consecutive star math tests, two months apart, and the data collected is used  to measure performance after two months of practice using video gaming platform prodigygame.com. The quantitative measure shows a modest increase in skill performance over the two months period of the research, for most of the target population. However, the performance of a few students did not improve, therefore, the  research needs to be continued and extended over a longer period, with inclusion of a general education class.

- *Keywords:*  Digital Natives, Video Games, Math Learning, Middle School, Math Confidence

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**Review of Literature**

This research paper explores the topic of using video gaming to increase math performance for 12- and 13-year-old students in the California public school system.  Multiple research papers address the topic of  using video gaming to increase student engagement in math learning ,with some research showing increase in learning outcome. Prensky (2001) found that for today's young learners the debate must no longer be about whether to use calculators and computers in math learning, but how to use them to instill the things that are useful to have internalized, from key skills and concepts to the multiplication tables. In his article (Prensky,2001) argues  that we should be focusing on concepts in math such as approximation, statistics, and binary thinking, as they are the most important  concepts for the future of math learning.

Boston et al.(2017) concluded  in a recent study, that using computer-based games for sixth graders to learn fractions showed an improved performance of the group who employed games to learn, over the group who used traditional learning methods. This research team developed their own games for learning modeling recreational video games, using differentiated  progression levels  to help students' engagement and continued learning while engaged in the game.

Byun & Joung (2018) found  that" Digital games (e.g., video games or computer games) have been reported as an effective educational method that can improve students' motivation and performance in mathematics education."( p.119).

The study of Chen et al.(2014),  focused on a peer assessment game development approach of 167 six graders, while eighty-two learned with conventional game development approach. This research looked  on improving students learning achievement and critical thinking skills, and their motivation. Improving students' motivation to spend time in an interactive math learning game and improving students' motivation by first helping them get confidence in playing, thus solving math without the anxiety involved in a traditional setting. Moreover, as the study found improvements for all three criteria considered by researchers, it supports my own efforts to improve my student's motivation and confidence in math learning, by using video gaming for math learning. According to Burguillo J.C. ( 2010) research, he concludes that "… the combination of game theory with the use of friendly competitions provides a strong motivation for students; helping to increase their performance." It is observed during this research that learners enjoy engaging each other in competitive learning, when they compete against each other for tokens and prices, when they attempt to get to the next level ahead of their peers, as this is all part of the unique environment which video gaming offers to learners. According to Garneli et. Al ( 2017) , they observed  that "…although only minor differences in learning performance were identified, we found significant differences in the attitudes of the students toward learning through the video game. Students who are not motivated by conventional paper-based assignments might be engaged better with the use of a video game." This is a very important characteristic to be noted, as maintaining motivation in math learning is an issue for many learners, who have a negative perception of math , and they lack confidence in their own learning abilities. The research of Plass at al. ( 2013), addresses the results of increased math performance based on competitive games , which , according to this research team "
…competition and collaboration elicited greater situational interest and enjoyment and invoked

a stronger mastery goal orientation. Game designing comes under scrutiny as a team of researchers' topic addressed the relationship between education and game mechanics: "The main goal is to establish an interaction between education and game mechanics. In addition, it was defined that another important mechanic used in games is "instant feedback". In addition, in line with the findings, it was detected that in-game rules, levels and awards facilitate learning and increase motivation." ( Alkan et al., 2021, p46.). In line with the conclusions of another research team, Toth et.al ( 2021), concluded that "….implementing gamification into the educational system has positive outcome on the student's engagement, motivation and the overall experience of learning." Although this study is performed with college level learners, it further affirms that gaming is supporting learning at different ages and learning levels. According to Noemi et al. (2014) , what makes educational games successful is their ability to engage and maintain an individual learner's interest and motivation by customizing the individual gaming and learning experience to each learner's preferences, needs, abilities, and most importantly goals. The research papers reviewed provide evidence that supports the hypothesis that gaming increases math performance by promoting engagement and motivation for the students.

**Methods**

Participants in this study are seventh grade math students who attend an after-school math support class, once a week. The math support class is joined by students on their teacher's

recommendation, after their first Star Math Test, in August. This test is administered to seventh graders four times during a school year, in August, October, February and April. The tests main s purpose is to evaluate and diagnose students' math skills and inform teachers of the areas and standards  students need to re-learn, practice, and improve on to get to at or above benchmark level. Students are invited to the after-school math support class, and video gaming was used to help students get engaged and stay motivated in their learning. For a period of two months, between February Star math test and April start math test, students were assigned practice on the prodigygame.com website video game platform based on the skills they needed to work on.  The research utilized a mixed method, combining quantitative data analyses and qualitative analyses, the later by  using journaling, and weekly reflections on students' participation, engagement and time spent playing the math videogame. The quantitative analyses are based on two tests taken on the same platform, Star Math. The February test is the pre-test,  and the April test is the post-test , as the results of these two tests are the data used for the quantitative analysis. Participating students are eighteen in total, out of which ten are  boys and eight are girls and two students are English learners, one boy and one girl. Attending the after-school math support class demonstrates a certain degree of motivation to improve their math skills and the hypothesis of the research is that using a video game-based learning medium will increase their math performance during their subsequent Star math testing, in April. The setting is a seventh-grade  public school classroom  equipped with Lenovo computers for all learners and online access to the gaming platform prodigygame.com. The access is provided through the district's internet connection, available to all students. Students are familiar with the gaming platform, as it is designed to be used for math learning starting from first grade through eighth grade ,and teachers in the district use it as an intervention and/or enhancement math tool to help motivate math learning.

For the  qualitative analyses researcher used  a field journal with weekly notes which document students' engagement for every day of attendance, from early February to end of April . Attendance was a challenge to keep the observations consistent, but overall, seventeen  out of the eighteen observed  students were present every after-school class for the period of two months, from the first week of February to  the last week in April. Prodigygame.com gaming platform has mostly  sessions of 15  to 20 min each, duration which keeps students actively engaged playing the game and being focused on working on the assigned math problems to get to the nest gaming level. Each student gets assigned practice problems to work on  skills for which they are diagnosed as being at urgent intervention, intervention or on watch. The pretest is the February Star Math Test for each participant; however, the gaming platform gives a placement test to each participants based on skills assigned by researcher. After the placement test the game assigned problems and questions which takes learners through those skills to practice independently, at their own pace, with teacher's support when not able to solve a particular problem to advance to the next level. The students who engaged with prodegygame.com consistently were seventeen out of the 18, which represents 89.5% with two outliners which showed sporadic interest and did not engage consistently. The field notes show that students who were started with a fifth-grade math skills evaluation by the gaming platform using the Placement test, got right away to play as they were in their comfort zone and had the skills to play the game to successfully get to the next level. The Placement test has forty questions, and it takes three to four 15 min sessions to be completed, or approximately three weeks. After the third week , according to the field notes, students started asking for support to solve problems, as they did not have the knowledge to do so but the game motivated them to try and get to the next level. The observations also attest that at this point students see math solving as a steppingstone to achieve the next level in gaming, and

not a daunting task on its own. The anxiety associated with the traditional only solve a problem approach was eliminated by engaging students in the math game. To practice specific skills , students were given assignments and the platform offers differentiation for the learners based on the outcomes of the assignments. After a two-month period, Post-Test was given  as the April Star math test, and the results were analyzed and compared to the pre-test  obtained by the target group in February.

## Results

**Two start math tests results for the target group were collected and statistical analyses were performed. In Tab. 1 Students are identified by number, gender, and  Star Math Scores during pre-test in February, and star math score post test in April. Microsoft excel was used for quantitative data analyses.**

| Student No | Gender | Star Math Score February | Star Math Score April |
|---|---|---|---|
| 1 | F | 1149 | 1104 |
| 2 | F | 1216 | 1194 |
| 3 | F | 1093 | 1081 |
| 4 | F | 1035 | 1135 |
| 5 | M | 1141 | 1163 |
| 6 | M | 1112 | 1185 |
| 7 | M | 1100 | 1100 |
| 8 | M | 1086 | 1163 |
| 9 | M | 1121 | 1070 |
| 10 | M | 1047 | 1067 |
| 11 | M | 1059 | 1083 |
| 12 | M | 1038 | 1044 |
| 13 | M | 1020 | 1120 |
| 14 | M | 1021 | 1021 |
| 15 | F | 1038 | 1064 |
| 16 | F | 1035 | 1103 |
| 17 | F | 934 | 1001 |
| 18 | F | 931 | 1023 |

| Star Math Score February | |
| --- | --- |
| Mean | 1065.333333 |
| Standard Error | 16.77630604 |
| Median | 1053 |
| Mode | 1035 |
| Standard Deviation | 71.1758386 |
| Sample Variance | 5066 |
| Kurtosis | 0.463021853 |
| Skewness | -0.034482007 |
| Range | 285 |
| Minimum | 931 |
| Maximum | 1216 |
| Sum | 19176 |
| Count | 18 |

| Star Math Score April | |
| --- | --- |
| Mean | 1095.611111 |
| Standard Error | 13.32650288 |
| Median | 1091.5 |
| Mode | 1163 |
| Standard Deviation | 56.53956334 |
| Sample Variance | 3196.722222 |
| Kurtosis | -0.743621738 |
| Skewness | 0.181594697 |
| Range | 193 |

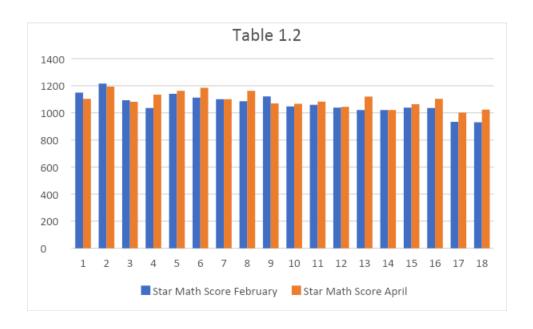| | |
|---|---|
| Minimum | 1001 |
| Maximum | 1194 |
| Sum | 19721 |
| Count | 18 |

*Average 'Star Math Score April' and average 'Star Math Score February'*
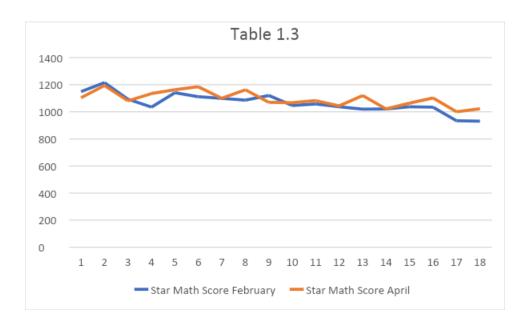
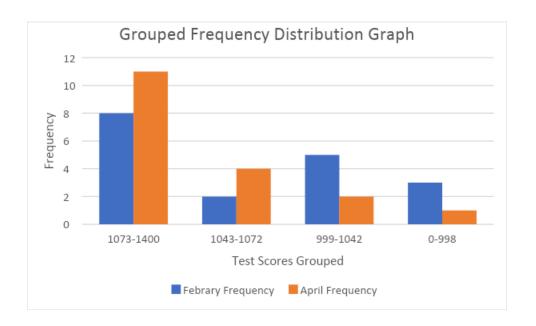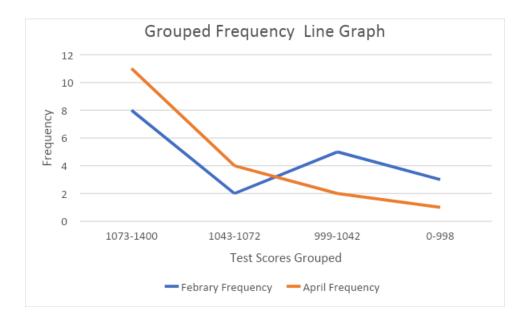| Average of Star Math Score April | Average of Star Math Score February |
|---|---|
| 1095.611111 | 1065.333333 |

t-Test: Paired Two Sample for Means

| | *Star Math Scores February* | *Star Math Scores April* |
|---|---|---|
| Mean | 1065.333333 | 1095.611111 |
| Variance | 5066 | 3196.722222 |
| Observations | 18 | 18 |
| Pearson Correlation | 0.736027874 | |
| Hypothesized Mean Difference | 0 | |
| do | 17 | |
| t Stat | -2.656217578 | |
| P(T<=t) one-tail | 0.008312187 | |
| t Critical one-tail | 1.739606726 | |
| P(T<=t) two-tail | 0.016624374 | |
| t Critical two-tail | 2.109815578 | |

Table 1.2



Table 1.3

| Grouped Scores | February Frequency | April Frequency |
|---|---|---|
| 1073-1400 | 8 | 11 |
| 1043-1072 | 2 | 4 |
| 999-1042 | 5 | 2 |
| 0-998 | 3 | 1 |



Grouped Frequency Distribution Graph

**Grouped Frequency Line Graph**



As per the hypothesis of this research , the results show an increase in math performance of the

sixteen out of eighteen students who participated in the after-school math support class. The

observations state that students showed motivation and engagement when given the opportunity

to play the math game, they got absorbed in the prodigygame,com assignment and were

interested in getting to the next level, asking for support from teacher, and sometimes classmates

to be able to continue playing.

**Discussion**

To confirm that the control and intervention group were starting from the same baseline, an independent-samples *t*-test was conducted to compare the pre-test score in the control and intervention groups. The *p*-value threshold for significance was set at 0.05. The effect size was measured using correlation coefficient (Pearson's *r*), for which commonly accepted size measures of Small, Medium and Large are 0.10, 0.30 and 0.50, respectively (Cohen, **1992**). There was no significant difference in the pre-test score for intervention (*M* = 8.48, SD = 4.49) and control (*M* = 8, SD = 3.68) groups; $t(128) = -0.65$, $p = 0.515$ and Pearson's *r* of 0.058. This confirms that before the coverage of fractions in class, there was no significant difference in the proficiency in fractions concepts in the control and intervention classes. Figure **9**a shows the distributions of pre-test score for the control and intervention groups.

The results of action research  support our hypothesis that gaming increases math performance of seventh grade students enrolled in an after-school program. The study had a small  group of students so the conclusions cannot be generalized across the board, and the gaming platform has not been evaluated for adherence to the math curriculum students follow in California public schools. However, the set of skills practice did align with the expectations in California math framework. There is need for more study of gaming applied in middle school math learning, and for this researcher the goal is to continue this inquiry  in the general education classroom which offers five hours of math classes per week.

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