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The Use of Handheld Video Games as Educational Tools in a Third Grade Classroom

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Introduction

The video game industry has grown into a multi-billion dollar industry and many of the industry's biggest customers are children. According to the National Institute on Media and the Family (2006) 83% of U.S. households that have children have video games and 92% of children between 2-17 years old play video games. Video games are gradually becoming accepted into classrooms as learning tools, but as the industry and gaming population grows it is important to continue to examine the topic of games in the classroom and their place in schools.

The motivation and desire to study and learn mathematics has suffered in schools in recent years. In a world where instant information and gratification are now commonplace there is a sense of boredom and lack of motivation when it comes to studying math and other subjects. In an age when children will have never lived in a world without cell phones, the internet, or videogames we have to look at ways teachers can utilize this generation's interests as motivational and teaching tools. This study will look specifically at implementing an extremely popular videogame system and educational game as a means of motivation and skill development.

Video games have been portrayed in the media in recent years now as having a negative influence on children. There is no question that much of the criticism is justifiable with the numerous studies that show how violence, obesity,

and poor grades can be related to games (Lynch, Gentile, Olson, & van Brederode, 2001; Green & Reese, 2006). But this doesn't discredit the possible usefulness games can have on learning with appropriate games and observation. Mark Griffiths (2002) insists that despite the possible negative results videogames can have, they have an equally high chance of having positive results. He points out that games grab the attention of children and create an interactive situation of learning.

So can the use of popular educational video games be used as a supplementary educational tool to help elementary students practice their math facts?

When examining this question and looking at the space and time restraints present it is likely that the use of a handheld video game system is the best option. The compact size and portability of a handheld gaming device also makes it much more practical than a traditional console or computer. Rosas, Nussbaum, Cumsille, Marianov, Correa, & Flores' (2003) research in Chile utilized Nintendo's Gameboy handheld system and the results of this study were positive partly because the Gameboys were not cumbersome to the class atmosphere. Choosing a handheld system should make for easy transitions from the games to the normal classroom work.

Nintendo's newest handheld system, the Nintendo DS, has created an educational gaming trend. The Nintendo DS utilizes touch screen and voice

recognition technologies to go along with the traditional buttons that make it an optimal device for educational games due to the kinesthetic possibilities and portability.

Rosas et al. (2003) created their own educational games based on aspects from popular games for their research. This study will focus on utilizing a game that is commercially available to students. The game selected for this study is very popular and readily available at any store that carries video games. Recently, many brain training educational games have hit the market on the Nintendo DS and they are not being passed by on the shelves. The game, Brain Age: Train Your Brain in Minutes a Day, is one of the highest selling Nintendo DS games in the world with more than 8.51 million units sold according to Nintendo's quarterly financial report (2006). This game is popular among adults and children alike. Brain Age boasts that playing just a few minutes a day will make your brain feel fresh and sharp. Studies have shown that children won't generally play educational games by choice, but would prefer to play educational games to traditional classroom instruction (Mitchell, A., Savill-Smith, C. 2004). With this in mind the game used in this study will contain many of the same features that children enjoy in recreational games such as – competing for high scores or fastest times, animated characters, tasks and goals to reach, problem solving, and fun (Mitchell & Savill-Smith, 2004).

Literature has shown in recent years that video games are great learning tools because they create a fun environment for play (Din & Calao, 2001; Mitchell & Savill-Smith, 2004; Rosas, Nussbaum, Cumsille, Marianov, Correa, & Flores 2003). The chance for learning is increased when the person is enjoying what they are doing. A major source of enjoyment for children is playing, and playing video games has become one of the more popular forms of play children choose in today's society.

According to Marc Prensky (2002) there are Five "Levels of Learning" while playing video games. The five levels consist of learning "How," "What," "Why," "Where," and "When/Whether." He describes that learning occurs constantly and naturally while playing games. While playing games children learn how to do things not only within the context of the game, but they also learn skills that they can apply outside of the game in the real world. He describes how children gain spatial understanding, understanding of different cultures and societies (both real and fictitious), and most importantly they can help children learn to make decisions, learn from their mistakes, and accept consequences for their actions. Prensky is referring to the benefits all games can have on learning. This study will focus on using educational games that will not incorporate the adventurous atmospheres that many of today's popular games incorporate. Instead, the focus will be on the incidental learning that can occur while the students are playing. Incidental learning occurs unplanned and naturally through

experiences and activities (Kerka, 2000). In order for the incidental learning to occur though students must be aware, focused, and involved in the activity.

Rosas et al. (2003) led a study in Chile that examined the use of a handheld video gaming device in the classroom. Their research team created games that utilized educational elements, focused on mathematics, reading, and spelling, mixed with traditional recreation gaming concepts. The students participating in the experimental classes was able to play their games for half-an-hour each day over the course of twelve weeks. The results of the study showed that the group of children who played the video games had significantly higher score improvements in math, reading, and spelling compared to the students in an external control group.

Rosas et al. research also analyzed student motivation and the classroom dynamics while the games were in the classroom. They observed frequency of students paying attention before and during the time when the games were in the classroom. They found significant improvements in the students' ability to pay attention while they played the games. There was also a significant improvement in student behavior while the games were in the classroom as well.

Quick mathematic fact retrieval, or automaticity, is an important skill students need to acquire during their elementary years. Single digit math facts are essential when working with multi-digit math problems and more complex math. Woodward (2006) studied the automaticity of math facts through an integrated

conceptual based math curriculum and basic timed math drills. Woodward exposed groups of students to either the integrated math and drill model or just the timed math drills. There was strong evidence that showed the integrated methods combined with the timed drills produced greater improvement in fact retrieval. The game used in this study will be a supplementary tool to the math curriculum. The researcher believes combining interactive math drill games with the traditional curriculum, similar to Woodward's study, will produce similarly desired results.

This study aims to use Rosas' research of using handheld games as its framework. But by using modern gaming technology and a very popular educational game, it is believed that playing an educational game just ten minutes a day will increase basic mathematical fact recognition.

Methods

Participants

A convenience sample of eighteen third grade students from the same classrooms will be participating in this study. The participants are students at a rural school. The majority of the students come from low socioeconomic status households. 52.1% of the 578 K-8 students receive free or reduced lunches according to the Office of Superintendent of Public Instruction of Washington

state (2007). Five of the students in the participating class are on an IEP, or Independent Educational Plan, in multiple subjects including math.

Eight students will be selected randomly and will be the experimental group that will be playing the video games. The other ten students will act as the control group. This study will not be studying any relationships to gender, but the classroom has a near equal number of male and female students.

Instruments

A worksheet of one hundred twenty math problems will be used. The worksheets will consist of single integer addition, subtraction, and multiplication problems. The math problems will be randomly generated using an online worksheet generator. The same test will be used to pretest and posttest the participants. The worksheet contains one hundred twenty problems to ensure that there are enough problems that a student won't run out of problems to work on. Because the researcher does not know the ability levels of the participants it is important to have too many problems rather than too few. The test can be found in the appendix.

Design

The games will be played on two Nintendo DS handheld gaming systems. These systems utilize dual screens, which create a more interactive environment

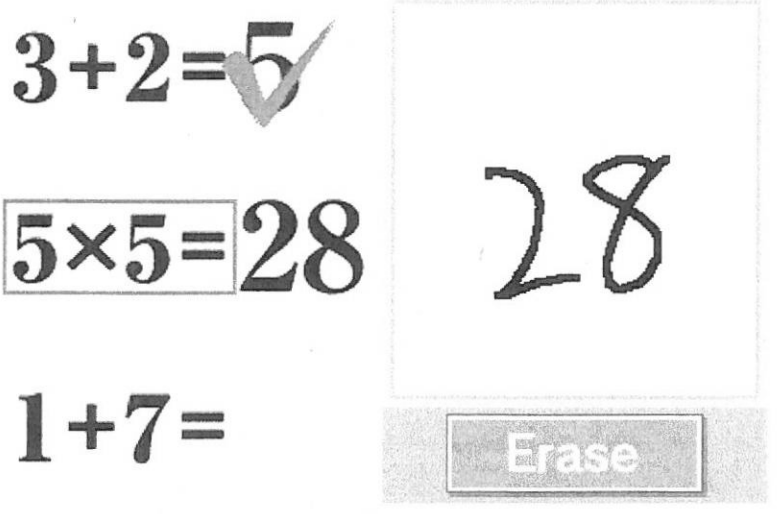
from traditional handheld gaming systems. The system's bottom screen is a touch screen. The game used in this study will require the students to hold the DS sideways much like they would hold a small book. The participants will be able to tap, touch, drag, and write their answers onto the touch screen using a stylus. The system also has a microphone that can recognize voice commands, but will not be used in this study. The touch screen feature will make playing the games more natural for all the students, especially the students that have little or no video game experience. The primary gameplay will consist of writing answers with a stylus and there will be no need for traditional button pressing.

The educational game used in this study, Brain Age: Train Your Brain in Minutes a Day, is rated E for Everyone by the ESRB (Entertainment Software Rating Board). This means that the game is appropriate for all age levels. The ESRB rates every videogame on the market today.

Brain Age: Train Your Brain in Minutes a Day includes fifteen different mini-game activities of which two are math mini-games that will be used in this study. These math-based mini-games consist of addition, subtraction, and multiplication calculations. These mini-games require the player to quickly recall the answers to basic math facts. The purpose of the game is to improve the player's "brain age" through daily practice. The game utilizes a calendar that keeps track of the player's practice time. The goal in the game is to achieve the perfect brain age of 20. The technology of the game is based on neurologist

Ryuta Kawashima's brain scanning research. Kawashima is also the digital guide through the game. The two mini-games the students will be playing will be focused on setting the fastest times in completing twenty calculations and one hundred calculations. The game marks the students' answers correct or incorrect as the student answers them. The program does not however give the child the correct answer if they answer incorrectly. Incorrect answers penalize the player with a five second penalty added to their final time. So the player must be fast and accurate with his or her answers.

Image 1 – Brain Age: Train Your Brain in Minutes A Day screen shot



Procedures

The experimental group and the control groups all will be given a pretest and a posttest. All students will take the tests together. A large digital timer will

be displayed using a projector. The students will have two minutes to answer as many questions as possible. When the timer buzzer sounds all students will stop immediately and place their pencils down. The researcher and the classroom teacher will conduct the tests. The pretest will be given on a Monday before the experimental group begins playing the game. The posttest will be given that following Friday afternoon. Between the tests the control group will continue their normal math classes as they have all year. The teacher will not change the normal teaching methods the students are used to.

The experimental group will be playing the game on a daily basis for one five-day school week. The students will be playing the games on a couch in the back of the classroom where they can relax and play the games. During the first playing session the researcher will introduce the students to the game interface and how to properly take care of the equipment. Each student in the experimental group will play the games in the classroom for about ten minutes per day over the course of the one-week period. Because of expenses the experiment will only have two Nintendo DS systems, but to ensure that students complete their daily playing and to reduce the chances of having to take time away from other class time they may play the game during non-math times, but the majority of the playing time will occur during the normal math schedule. The experimental group will not alter anything from the normal schedule so that the students'

school experience stays relatively unchanged, outside of the games, from the control group.

Analysis of Data

A *t*-test was conducted on the data gathered from the pretests and posttests to determine if there was a significant difference between the means for each group. Four students were removed from this study due to absences on either the day of the pretest or the posttest. One student from the experimental group was absent from the posttest and three students from the control group were absent from the pretest. This brought the total number of participants from the study down from eighteen to fourteen. The experimental and control groups had an equal number of participants, seven, that were able to complete both the pretest and posttest. This data analysis will see if there were any significant gains from the pretest to the posttest for either group. The data is presented in the chart below:

Pretest and posttest gains analysis

		Pretest		Posttest		
Group	N	M	SD	M	SD	Mean Diff
Control	7	14	8.124	16	10.504	2
Experimental	7	14.43	7.345	19.86	8.688	5.43*

* significant, $p<.05$

There were mean gains in the scores of both groups, but there was a significant gain in the experimental group at a $p<.05$ level. There was not a significant gain in the control group. This analysis demonstrates the impact that playing the educational game for just ten minutes a day during one school week can possibly have on a child's mathematical facts recognition.

The hypothesis that these simple calculation games can be a supplementary practice tool in the classroom was supported by the results of the experiment. These games are not designed to specifically teach the children their mathematical facts, but more to practice them and keep their minds fresh. This is not to say that the students can't learn from the games. The students definitely were able to learn and remember new mathematical facts through repetition of the game.

While the students were playing the game the researcher observed the progress of the students within the game. The students' progress was not recorded and analyzed statistically, but the researcher observed improvement in the times from each student in the experimental group. The students were motivated to improve their times. It was observed that while the students were playing they learned from their wrong answers and once they were able to figure out an equation, for example 8x9 equals 72, they were able to replicate that answer within the game almost every time that question was on the screen. The students also demonstrated frustration from the challenge of the game. The

traditional entertainment videogames children choose to play in their free time present challenges and difficulties that students enjoy and strive to accomplish. The researcher observed the same desire to improve and compete with this educational game.

The classroom teacher made observations as well. Her observations paralleled the researcher's observations in many ways. The most prominent observation she made though was the sense of calm about the students while playing the game. According to the teacher, the students' excitement and willingness to play the game was something that impressed her. She also commented on how impressed she was with the control group and their acceptance of the fact that they were not going to be able to play the game. She was impressed that the games were not an issue within the classroom and instead of creating behavior problems it may have reduced them.

Discussion

This research was under time and financial restraints therefore the possibility of producing a large-scale experiment was not feasible. The researcher would like to do more research utilizing the technology and games with a larger population. The validity of this study is not very strong due to the small population used and the short amount of time spent playing the games. A larger population and more time spent during the experiment will allow for results that

are stronger. The researcher would also like to investigate the impacts the other mini-games within Brain Age and other brain training games can have on student learning.

Due to the Nintendo DS being a more modern technology there is very little research available that utilizes the DS. The researcher feels this is an important study that will hopefully lead to future research using the touch screen and hopefully the microphone technologies available on the DS. The portability and kinesthetic possibilities need to be examined to a greater extent.

There will likely be advocates against more screen time for children who are already getting enough. This is why the researcher chose the game and technology used in this study. Short daily playing stints for practice and repetition will maintain the children's attention and motivation to practice studying their math facts through playing a game, and it won't cost the children a lot of screen time per day.

Utilizing this kinesthetically driven technology has potential to help students practice and study while independently recouping. The researcher made observations of students that were able to refocus their attention after their short ten-minute gaming session. The kinesthetic hands on gaming experience took a few highly active students from antsy to calm in but seconds of starting their game. The possibilities of the positive behavioral effects the DS and games can have on students that have special needs and suffer from problems such as

ADHD, social divergence, emotional divergence, and other possible learning disabilities could be beneficial. Future research in this area will hopefully provide positive results and increase the likelihood that the DS technology becomes a supplementary option for more than just educational and entertainment reasons.

The researcher suggests that teaching a variety of different problem solving methods of basic math facts is an important step in the students developing solid conceptual understanding of math. In doing so this technology could be a major addition into the practice and motivation of student development. Educators will be able to utilize the gaming technology as a means of motivation and short practice sessions to coincide with the conceptual learning. At some point students need to be able to practice their math facts. The motivation for many students can become negative towards worksheet math drills. The idea of playing with a commercial videogame system to practice their math rather than just practicing their math the traditional way will have a large impact on the motivation of most students. The students from the experimental group would ask numerous times throughout the day when they could play the game. Some students would offer to stay in during recess to play the game as well. Many students from the control group also asked if they were going to get a chance to play the games. Many of the students said they would not be as excited and eager to practice their math facts if they didn't get to play the Nintendo DS.

The overall positives of utilizing a popular educational game, like Brain Age, and an interactive handheld system like the Nintendo DS greatly outweigh the negatives. The ease of integration and use make it a perfect supplementary tool. Naturally, a teacher will need to take precautions due to the general perception videogames can have. But having the opportunity to use an effective educational tool that today's youth can relate to and love should not be passed up.

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Appendix

1. 5 x 0	2. 9 x 1	3. 10 x 8	4. 8 + 6
5. 9 - 4	6. 12 x 0	7. 0 x 2	8. 8 x 4
9. 0 x 3	10. 12 - 2	11. 8 + 1	12. 10 + 9
13. 5 x 2	14. 9 - 0	15. 3 + 0	16. 0 + 6
17. 6 - 1	18. 9 + 3	19. 1 + 6	20. 11 - 9
21. 5 + 0	22. 3 - 0	23. 2 + 0	24. 0 + 1
25. 8 - 6	26. 11 - 4	27. 5 + 6	28. 6 + 4
29. 9 - 5	30. 6 + 7	31. 10 + 7	32. 1 x 2
33. 4 x 2	34. 11 x 4	35. 3 x 6	36. 9 - 2
37. 8 + 6	38. 7 - 1	39. 2 + 3	40. 12 x 9

41. 9 x 0

42. 9 x 5

43. 5 + 6

44. 1 - 1

45. 12 - 9

46. 3 + 8

47. 9 + 6

48. 5 + 9

49. 3 - 2

50. 4 x 4

51. 8 x 9

52. 10 + 5

53. 12 - 7

54. 8 x 9

55. 6 + 4

56. 8 - 3

57. 11 - 4

58. 8 - 8

59. 9 + 9

60. 6 + 7

61. 9 + 8

62. 5 + 2

63. 1 + 4

64. 3 + 5

65. 11 - 9

66. 4 + 6

67. 7 x 1

68. 1 x 1

69. 0 x 2

70. 7 + 1

71. 11 x 6

72. 10 x 5

73. 4 - 0

74. 6 + 5

75. 6 x 7

76. 8 x 1

77. 11 - 4

78. 5 - 1

79. 11 - 5

80. 5 + 9

81. 3 - 1

82. 12 - 9

83. 12 - 8

84. 0 + 1

85. 11 + 7

86. 4 - 4

87. 2 + 4

88. 9 + 0

89. 7 - 2

90. 8 x 9

91. 8 - 1

92. 5 - 1

93. 12 + 6

94. 5 - 1

95. 7 x 0

96. 12 - 8

97. 10 + 3

98. 7 + 9

99. 8 x 9

100. 11 - 1

101. 5 + 4

102. 7 x 0

103. 10 - 1

104. 3 x 6

105. 2 x 7

106. 1 x 2

107. 8 - 3

108. 9 + 7

109. 9 + 0

110. 8 - 3

111. 11 x 8

112. 3 + 5

113. 9 - 0

114. 6 x 6

115. 10 x 1

116. 6 - 4

117. 3 x 8

118. 6 x 0

119. 2 x 3

120. 8 - 3