What are the Effects of Utilizing Digital Games During Instruction?

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This participatory action research project examined digital game-based learning and its effects in a technology-enriched classroom with elementary school students ages 8 to 11. Experimental and control groups received identical content instruction with differing instructional strategies during 8 lesson cycles. Student observations and attitudinal surveys constituted data sources to determine which student group had a higher level of engagement and time-on-task behavior. The results indicated the experimental groups that utilized digital game-based learning showed higher attentiveness and student engagement compared to the control group’s lesson cycles in most of the testing trials.

Background

Towson University (TU) sponsored an Action Research Fellowship for an in-service teacher who implemented action research in his or her classroom. The fellow received guidance during the action research process from experienced TU faculty members. The research occurred inside a technology classroom at Clarksville Elementary School (CES) located in Howard County, MD.

Under the former administration at CES, action research or other inquiry-based practices were used as a means of teacher professional development. Participation in the TU Action Research Fellowship was voluntary with each fellowship candidate having to undergo an approval process with a selection committee. This project proposal was selected for sponsorship and the collaboration took place over a time period of 15 months from proposal selection to final submission.
Methodology

Overview
This experimental research project utilized participatory action research inside an elementary school technology course. The study examined student attention and engagement during 8 lesson cycles. CES is a K-5 public school with self-contained classrooms. The experimental group participated in a technology lesson that used digital games as its method of delivery or practice for the students. The control group participated in a technology lesson that utilized an alternative learning strategy. The alternative learning strategies selected for comparison with Digital Game-Based Learning (DGBL) included: a) carousel brainstorming, b) team webbing, c) concept attainment, d) jigsaw, e) learning stations, and f) roundtable. These alternative learning strategies were interactive, stimulating, and engaging for students. Research data was captured in the form of student observations and post-trial student surveys. Both groups were taught the same technology and content objectives utilizing varying instructional strategies.

CES students attended technology class one hour a week in their homerooms as part of their related arts schedule. A random student table was selected to observe time-on-task behavior in a 120 second interval during the experimental and control group’s lessons. The student table observations examined time-on and time-off task behaviors during the independent work time of the lesson. At the conclusion of the lesson, each student in the control and experimental groups completed an electronic survey disseminated and captured by Google Forms. This method of survey dissemination allowed students to complete the survey while remaining anonymous. For the student table observations, a subject would pick a card at random with a table number on it. This number represented the table to be observed during the independent work time.

Student Participants
CES has a total enrollment of 554 students, with 60% of the student population categorized as White, and almost 31% Asian. Only 0.2% of the student population qualified for the Free and Reduced Price Meal Service. Grades 3 through 5 at CES contain approximately 280 students in 12 different homerooms. All intermediate students participated in the technology
class lessons. A consent form was sent to all participating student families with no parents or guardians opting out of the research study. The study was granted permission to begin by the Institutional Review Board at Towson University. School-based approval was requested and granted by CES administration.

**Classroom Implementation**

Lesson Objectives, motivations, instructional materials, and closing activities remained consistent throughout the entire study. Content and technology objectives were based on Howard County Public School System Curriculum. The standard technology enriched lesson plan outline included: (a) Review of Objectives, (b) Student Motivation or Warm-Up, (c) Direct Instruction, (d) Independent Activity, (e) Assessment, and (f) Closure. The main differences between control and experimental group lessons were the methods or tools used during independent work time and the lesson assessments. The lesson assessment received only minor changes to reflect instructional differences between the independent activities in the experimental and control groups. Most digital games were browser-based games that required a computer workstation and an Internet connection. If a lesson extended past the 60-minute class period, then it was revisited during the next class meeting. The student table observations and post-surveys were completed once despite a lesson extending more than one class period.

**Data Collection**

Throughout the 8 trials student observations were conducted in both groups to compare time-on-task behavior between each testing group. Time-on-task refers to the amount of time students spend attending to school-related tasks such as following directions and engaging in learning activities (Prater 1992). One table selected at random in each group of the trial was observed during the independent activity of the lesson. The 5 to 7 students seated at the randomly selected table were observed for a 120 second interval to record time-on-task behavior. The time-on-task behavior results were averaged to determine which lesson produced the higher time-on-task behavior.

Each student participant in the control and experimental groups completed a post-lesson exit survey to rate certain aspects of the lesson. The survey was
disseminated using *Google Forms*. *Google Forms* allowed students to click on a hyperlink to access and complete the survey anonymously. The survey results were collected and easily organized into spreadsheets for analysis.

Question 1 instructed students to select the group in which they were participating. The student participants were asked to select (c) for control or (e) experimental from a drop-down menu. The evaluator instructed student participants to select one without divulging the context of their answer selection. Question 2 asked students to identify their grade levels for demographic data sorting. Question 3 suggested enjoyment during the independent practice is related to student engagement during digital games. In the context of a game, fun can be a component of an engaging experience (Whitton 2009). A Likert scale was utilized with 5 being rated as “very fun” to 1 being rated as “not fun.” Question 4 asked students to self-rate their attention during the instructional activities on a Likert scale. Students had to rate themselves utilizing a Likert scale with 1 indicating a “Not Focused” rating to 5 indicating a rating of “Really Focused”. For questions 3 and 4 a score of 5 and 4 on the Likert scales were rated as a positive score, 3 was rated a neutral response, and scores of a 2 and 1 indicated a negative score. Question 5 was an open text box that collected anecdotal comments about the instructional activities. These comments were rated as positive, negative, and neutral dependent upon the nature of the comment. Positive comments included fun, cool, awesome, or similar adjectives describing satisfaction with the digital game or instructional strategy. Negative comments included boring, too easy, not fun, or a similar negative descriptor. A neutral statement consists of a response with both a positive and negative descriptor in it or a statement that was ambiguous or did not relate to the lesson. Several examples of neutral comments include game was fun but too easy, computers are cool, no hangman, medium, or other descriptor demonstrating neutrality.

**Data Analysis**

Student observations were the first data collection tool used to evaluate time-on-task behavior in the control and experimental groups. Seven of the 8 class="msoIns" trials (See Table 1) produced higher time-on-task table group averages for the experimental group. The trial that produced a higher group
average for the control group was a group activity that promoted kinesthetics in the classroom with constant student rotations and new challenges to solve. Body movement is a lesson attribute many young students cherish since they are at an extremely vibrant period of their lives.

**Table 1:** Averages for Table Group Observations (120 second intervals)

![Bar chart showing averages](chart.png)

The results for question #3 on the exit surveys were quantified into class mean scores (See Table 2). When compared, the experimental group produced mean scores higher than that of the control groups in 7 of the 8 trials. The trial that favored the alternative learning strategy (control group) utilized a multimedia project. Multimedia projects have a tendency to be very popular amongst students. The DGBL activity utilized a quiz format similar to a television show. The data suggests that the multimedia project was more enjoyable for students than the quiz show game. The result of this particular trial demonstrates the high degree of motivation for incorporating technology into the curriculum and sometimes that technology approach is not DGBL.

**Table 2:** Class Mean Scores for Activity Enjoyment
The final question of the exit survey was an open comment box to collect reactions to the experiences in each group (See Table 3). Completing the comment boxes on the exit survey was voluntary. The responses were typically the length of a short phrase or sentence. A total of 264 responses were collected from students over the course of the 8 trials. The control group produced 120 comments, with 64% of them being identified as positive. The experimental group produced 144 comments, with 77% of them being identified as positive. The DGBL activities received a higher percentage of positive comments over the alternate strategies. Survey data supports that a large majority of students enjoyed the DGBL activities (see Table 3).

**Table 3:** Open Comment Box Results
Conclusion and Classroom Adoption

The data from the study suggests Digital Game-Based Learning is a sound instructional strategy that enhances a high percentage of lesson plans. The New Horizons Report (Johnson, L., Levine, A., Smith, R., & Haywood, K. 2010) suggested that DGBL would be adopted into many educational settings within the next 2 to 3 years. It has a proven track record in the military and corporate sectors. The adoption into mainstream education may experience some resistance. Certain taboos about digital games must be overcome before the education field embraces it. Digital Game-Based Learning should not be discounted as a waste of time or a way to pacify students with a fun but meaningless task. The data from these particular trials indicates that DGBL groups showed more student engagement and time on task behavior than the alternative strategies. However, several trials did demonstrate that the alternative strategies produced more lesson engagement and a higher time-on-task group average than DGBL. A conservative assumption suggests DGBL can be as engaging an instructional strategy as alternative research-proven learning strategies. It should be emphasized that utilizing DGBL is not always the best teaching practice. Games are not necessarily an appropriate way to teach everything — if you are finding it really difficult to think of a gaming activity then it could be that a game is not suitable in this instance (Whitton 2009). Digital Game-Based Learning, as with any instructional tool, must be appropriate to the task. Teachers should consider incorporating DGBL into instruction to provide a fun and engaging experience for their students.
References


Appendix A – Student Survey
Gaming Action Research Activity #2 - Dance Mat Typing

Please read the directions and answer the questions.

* Required

Class type? *
Please choose the one the teacher tells you to.

Control

What grade are you in? *
Please choose from the list.

3rd

Please rate on a scale of 1 to 5, with 5 being the most enjoyable, rate your experience with the Dance Mat Typing activity. *

1 to 5 scale

1 2 3 4 5

Not fun o o o o Very fun

How focused were you on the game? *
Pick the one that best fits your opinion.

〇 Really focused
〇 Focused
〇 Paid attention a little
〇 Did not focus on the game

Please add any comments you have about the activity.

Appendix B – List of Digital Games

(BBC) Dance Mat Typing – an online, interactive, flash-based typing tutorial for students.

http://www.bbc.co.uk/schools/typing/

City Creator – a city-building website that allows users to create their own cities or towns.

http://www.citycreator.com/
ReadWriteThink Construct a Word – use letters, digraphs, and consonant clusters to create words.

http://www.readwritethink.org/materials/construct/index.html

SmartTutor : Prefix and Suffix Level 3, Volume 1 – use a balloon to collect gems and match prefixes and suffixes.

http://smarttutor.com/home/lessons/Vocab_PrefixSuffix_L3_V1_T3a.swf

Scholastic: Maggie’s Earth Adventures (Short Circuit) – match base words to a prefix and suffix while clicking toggle switching to make a the electrical connection.

http://www.missmaggie.org/scholastic/shortcircuit_eng_launcher.html

Compost 4 Fun – users guide a person through a house and yard to find materials to place into a compost bin.

http://www.bravekidgames.com/flash_game_home_compost.php

Fun with Food Webs – create food chains and webs in different settings natural settings.

http://www.harcourtschool.com/activity/food/food_menu.html

Gould League Food Webs - create food chains and webs in different ecosystems around the world.


The Food Chain Game – create simple and complex food chains.

http://www.sheppardsoftware.com/content/animals/kidscorner/games/food

Our Courts – Supreme Decision – interact in a simulation of a mock
supreme court trial

http://ourcourts.org/flashgames/1/

Planet Green Game – travel around a community and lower Greenhouse emissions around by answering questions, performing activities, and demonstrating good green behavior.

http://www.planetgreengame.com/game.php

Yard Sale – teaches the important aspect of reusing. Players must select objects to sell at a yard sale for the goal of earning enough money to build a tree house.

http://www.ecokids.ca/pub/eco_info/topics/waste/yard_sale.popup.cfm

Grow and Learn – students learn fundamental aspects of gardening and raising plants by playing simulations games demonstrating gardening skills.

http://www.growandlearn.org/

Bloomin’ Garden – users learn about common garden flowers and explore species competition in this problem solving gardening activity.

http://www.learn4good.com/games/online/blooming_garden_flower_powe