DOES DIGITAL GAME-BASED LEARNING IMPROVE STUDENT TIME-ON-TASK BEHAVIOR AND ENGAGEMENT IN COMPARISON TO ALTERNATIVE INSTRUCTIONAL STRATEGIES?

Ryan Schaaf
College of Notre Dame of Maryland

ABSTRACT

Digital Game-Based Learning (DGBL) activities were examined in comparison with effective, research-based learning strategies to observe any difference in student engagement and time-on-task behavior. Experimental and control groups were randomly selected amongst the intermediate elementary school students ages 8 to 10 years old. Student observations and attitudinal surveys were completed after eight lesson cycles to determine which student group had a higher level of engagement and time-on-task behavior. Six of the 8 trials showed a higher student survey average in the level of student enjoyment while experiencing DGBL. Six of the 8 trials produced equal or higher class average scores for focus and attentiveness during DGBL versus alternative strategies. Seven out of 8 trials produced higher student table observation averages for DGBL. In conclusion, the data suggests DGBL can be as effective in the classroom as other research-proven instructional strategies.

BACKGROUND

Clarksville Elementary School (CES) is located in Clarksville, MD, an affluent neighborhood in the Baltimore/Washington corridor. It is one of the 39 elementary schools in Howard County, Maryland, one of the top public school systems in the United States. Howard County's schools frequently rank first in Maryland as measured by standardized test scores and graduation rates. 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.
CES utilizes action research and educational research book studies to drive staff professional development. CES administration is very supportive of conducting research to advance professional development and encourages the implementation of research-based best practices into classroom instruction. Small clusters of staff members called Critical Friends Groups (CFG) hypothesize a particular research question(s) and implement interventions, collect and analyze program data, formulate conclusions, and incorporate research results into the CES School Improvement Plan.

Teachers utilize numerous forms of instructional strategies to deliver lesson content. The CFG examined whether students were more engaged and attentive in a digital game-based learning (DGBL) activity or in an alternative learning activity during classroom instruction. Digital games were mostly browser-based games found during a web search (see Appendix). The games were produced by numerous publishers and were pre-screened to determine if they met lesson objectives. Some of the alternative learning strategies selected for comparison with DGBL included: a) carousel brainstorming, b) team webbing, c) concept attainment, d) jigsaw, e) learning stations, and f) roundtable. These alternative learning strategies are interactive, stimulating, and engaging for students. This action research project compared the time-on-task behavior and student engagement between DGBL and a myriad of alternative learning strategies. The information and content remained the same throughout each lesson to isolate the control and experimental group from all other instructional variables. Learning strategies changed between the control and experimental groups to test the banner questions. There were 8 lesson cycles examining 16 instructional hours of content. Each lesson cycle contained 2 classes: one an experimental group utilizing DGBL as an instructional strategy, while the control group used an alternative strategy. The results from the student surveys and group observations helped determine if DGBL was as effective an instructional strategy as other instructional strategies.

**LITERATURE REVIEW: DIGITAL GAME-BASED LEARNING**

Advancements in digital technologies such as computers, mobile devices, and telecommunication have provided the 21st century world with limitless possibilities. The fields of education and training are starting to take advantage of these technological advancements. Classroom instruction has been infused with digital tools to provide dynamic and creative learning opportunities for students. Incorporating technology and utilizing effective instructional strategies during classroom instruction will help prepare the 21st century learner for a globalized job market. One distinct facet of technology instruction that has a wealth of potential is Digital Game-Based Learning (DGBL). Sanford and Madill (2007) concluded that video games are one of the new literacies that offer powerful learning in cultural literacy dimensions. Game players are exposed to values, rules, standards, and multiple perspectives they must possess to function in future jobs. First, DGBL mirrors how humans think and how the mind functions. Gee (2007) stated video games externalize the way the human brain thinks and good video games often organize learning in effective ways. Next, DGBL provides collateral learning opportunities in a media rich society. Also, 21st century learners prefer to learn information utilizing 21st century methods; “The Games Generation’s minds have been programmed to adapt to
greater speed and thrive on it" (Prensky, 2001, p. 52). Furthermore, DGBL utilizes numerous intelligences providing the learner with a better opportunity to understand and retain new information. Digital games have a versatile nature allowing for easy adaptability dependent upon the situation and can provide a safe alternative to reality. Next, DGBL is a unique media for fostering collaboration and problem solving skills. Gee (2007) described how good video games show that collaboration and participation with others is needed for engaged thinking and learning. On the other hand, it also promotes individuality and self-reliance. Finally, gaming is a popular and motivating form of entertainment.

Instructional technology tools such as computer-based games present information in a more consistent manner with how the human brain learns. Computer-based games provide simulations that often mirror cognitive functions in the brain. Humans think and learn through experiences. They run simulations in their heads based on those experiences, much as if they were playing video games in their head. Humans can think about what they are going to do. They can imagine the scenario and think of the actions involved in completing the goal or task. Simulations help the human mind make sense of things and prepare for actions to take place. “Video games may give us deeper insights into human thinking and learning, as well as engage learners in deep and engaged learning” (Gee, 2007, p. 28). Video games have the ability to disseminate information and to produce higher-level learning situations. “Computer games can now be used for primary learning of really hard subjects, including people management, difficult-to-learn software, complex financial products, and intricate social interactions” (Prensky, 2001, p. 20). Training is an expense all corporate, military, and education institutions face. Digital Game-Based Learning provides experience and knowledge most students or trainees will excel in.

Advancements in information and communication technologies (ICT) have ushered in a digital age. The digital age provides unorthodox methods of learning information. Media sources surround citizens in developed countries. People are constantly bombarded with information. Information is being disseminated quickly and to a wide range of users. Learning is occurring in the background during everyday life. Youth living in the digital age learn in a considerably different manner than in previous generations. Numerous media outlets have provided children with a method of learning without direct awareness. A detective show can teach vocabulary such as forensics or felony. The show’s main purpose is to entertain, but collateral learning is taking place. Video games teach information in much the same way as the detective show. Demski (2009, p. 34) wrote of an educational online community of teachers utilizing the World of Warcraft, a Massively Multiplayer Online Role-Playing Game (MMORPG) for networking, professional brainstorming, and personal enjoyment. Catherine Parsons, an Assistant Superintendent in New York State and a participant in the online community listed the numerous educational skills needed to play World of Warcraft. Players must read, communicate with other players effectively, access analytical skills and problem solving skills, and thrive in a native economy. This type of multi-disciplinary learning opportunity is valuable because it reflects how people encounter challenges and find a solution in the real world. Information is processed in the human brain into knowledge from media outlets and other resources. “Digital Game-Based Learning works because of the engagement that comes from putting the learning into a
game context” (Prensky, 2001, p.147). Users get to experience theory and explore new ideas in a virtual gaming environment. Learning does not only have to occur in an educational setting. People gather information consciously or subconsciously while interacting with a media source such as computers, video games, or television programs.

The digital age provides twenty-first century learners with the ability to learn using twenty-first century methods. Advancements in ICT and the improvements in computer performance provide learners with new methods to learn and retain information. The traditional educational setting is far behind other industries in embracing new, experimental methods of disseminating information to people. The traditional methods of instruction in today’s school setting have not changed in centuries. The high-speed evolution of the digital age and the difficulty in causing any type of change in education has caused digital divide amongst digital age students and educators. “It is becoming clear that one reason we are not more successful at educating our children and workforce, despite no lack of effort on our part, is because we are working hard to educate a new generation in old ways, using tools that have ceased to be effective” (Prensky, 2001, p. 17). The students and young employees of the current generation have never experienced a world without computers, video games, or cell phones. This generation is also under the impression that using these ICT resources is taboo. “The use of information and communication technologies (ICT) within school settings is often cast in an unfavorable light when compared to young people’s rather more expansive engagement with digital media outside the classroom” (Buckingham, 2007; Cuban, 2001, p. 919). The education and training fields must embrace the advantages ICT provides for its students and employees. A study (Selwyn, Potter, & Crammer, 2009) investigated children’s engagement with ICT inside and outside of school. The study concluded that educational technology stakeholders should encourage informed dialogue with young people about the potential benefits of ICT in the classroom. Digital games are one of the aspects of ICT that students and employees may gravitate to. Derryberry (2007), in exploring the use of serious games, a digital game genre created specifically with the intention of improving some aspect of learning, stated that “21st century learning experiences need to reflect the lives of 21st century workers. While there is skepticism that something called a game could be anything more than leisure activity, serious organizations are getting serious results with serious games” (p.1). DGBL is already being utilized in numerous private and public sectors. The United States military has been incorporating DGBL for decades, training the millions of officers, enlisted soldiers, and support personnel necessary for its prosperity. Many of the video games of today are the result of the research and funding of the United States government. Big corporations have also utilized DGBL to train employees in customer service, sales, safety, and recruiting to name just a few. Education seems to be the field that constantly lags behind in innovation and redirection. ICT has the potential of transforming the field of education.

Computer-based games attract many users with different learning styles and intelligences. “Each learner’s intelligence profile consists of a combination of relative strengths and weaknesses among the different intelligences: linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, naturalistic, interpersonal, intrapersonal, and (at least provisionally) existential” (Gardner, 2006) (Koran, S., Kornhaber, M., Gardner, H., 2006, p.
Most computer games are designed with visual and auditory skills in mind” (Gee, 2007, p.24). The visual and audio interface provides a robust source of information to which the human brain quickly interprets and responds. Other intelligences are also present in some advanced digital games. The versatility of game design and available hardware resources provide game users with a variety of multiple intelligence experiences. The musical intelligence is invoked by background music that sets the tone of the game experience. The linguistic intelligence is accessed through games with virtual agents interacting with the game player. The virtual agent shares vital information for successfully navigating the digital gaming experience. Current and emerging gaming technologies are adopting new methods of gaming interaction. The traditional gaming interface includes keyboards and joysticks. New gaming interfaces include more mobile sensory tools. These new tools provide a wider range of motion allowing individuals with an affinity towards the bodily-kinesthetic intelligence to interact with the gaming system utilizing their preferred learning preference. Internet technologies provide the ability to communicate with others using text and audio. Many games have incorporated communication tools into the game format. These tools allow individuals with strength in interpersonal relationships to collaborate to achieve game objectives. In contrast, digital games continue to be mostly focused on the individual player. The storyboard of a typical digital game presents a problem for the player to solve or an objective for them to complete. Players must become self-reliant, confident, and creative. Collaboration and cooperation are extremely useful abilities in the 21st century. However, people must learn to rely on themselves as well; “Playing such games helps people develop a sense of identity, grasp meaning, learn to follow commands and even pick role models” (Games lesson, 2009). The individual player must rely on their intrapersonal skills and abilities to succeed during game play. Finally, game content and design has a way of blending the intelligences together. For example, a game may have aspects that a visual learner, linguistic learner, or spatial learner will find useful or excel in. This blended learning experience will attract more users since it is tailored to meet the needs of many users. Digital Game-Based Learning is an instructional approach that provides many individuals with the ability to learn new information utilizing their preferred learning style and intelligence sect.

The versatility of DGBL provides designers, educators, and trainers with the advantage of teaching almost any subject matter. The numerous platforms supporting digital games allow trainers and educators to teach their pupils no matter what their budgets are. Internet websites host millions of interactive digital games. Software companies generate thousands of programs designed to educate and entertain, coining the phrase Edutainment. Finally, many companies with the training budget, technology infrastructure, and a development team have created their own DGBL training modules. One of the main reasons to use DGBL in a corporation is the interactivity it brings to the training program. Prensky (2001) concluded that DGBL works because of the interactive learning process employed. He also stated that it comes in many different forms depending on the learning goal “Research and experience are starting to show that games can clearly be applied very effectively in many learning contexts” (Johnson, Smith, Levine, & Haywood, 2010, p. 19).
The 21st century job market requires more team-based interaction to accomplish professional duties and responsibilities. Communication and collaboration skills are in need for workplace success. Employers require their staff to solve problems by working together. Corporations and educational institutions utilize individual knowledge present in each student or staff member and distribute it for the group to benefit. A means of practicing this group knowledge distribution is present in some digital games. “Good games distribute intelligence. By distributing knowledge and skills this way between the virtual characters and the real-world player – the player is guided and supported by knowledge built into the virtual character” (Gee, 2007, p. 27). Individuals working or learning in a collaborative atmosphere must become accustomed to brainstorming solutions to problems in a group. Problem solving and collaborative skills are not the only learned behaviors associated with digital games. Gee (2007) described video gaming as being a deeply social enterprise. Digital game communities are spread out all over the Internet. Many of the individuals receive very little recognition for sharing knowledge other than the experience of helping a fellow online game player. “Even single player gaming often involves young people in joint play, collaboration, competition, sharing, and a myriad of websites, chat rooms, and game guides, many produced by players themselves” (Gee, 2007, p.20). Corporations and educational institutions must try to replicate the success of the digital gaming communities into its workers or students.

One of the biggest factors for the adoption of DGBL is its popularity in today’s society. The gaming industry generated over twenty billion dollars of revenue in 2009 (Brightman, 2010). People want to have fun and enjoy themselves while learning. Gee (2007, p.10) stated, “Good video games are hard work and deep fun. Pleasure is the basis for learning for humans and learning is, like sex and eating, deeply pleasurable for human beings.” Adolescents are at the apex of their development. Children learn just as much while playing as in an educational setting. Developmental psychologists such as Piaget and Vygotsky wrote that children’s play helps social, intellectual, and emotional development (Shaffer; Gee, 2006). DGBL helps humans play to learn and learn to play.

Technology keeps advancing, creating training for people in potentially dangerous professions “Simulation training is an excellent way to prevent disaster” (Skurzynski, 1991, p. 32). In order to prevent a catastrophe, personnel must be trained extensively. Digital Game-Based Learning allows recruits to train in the same manner they would if they were at the controls without the consequences of making deadly mistakes. Gee (2007, p. 24) stated, “You build your simulations to understand and make sense of things, but also to help you prepare for action in the world. You can act in the simulation and test out what consequences follow, before you act in the real world.” An example might include a simulation of a nuclear reactor. The simulation can instruct the learner in reactor functions, but also help them understand the potential consequences for mistakes or give background information pertinent to the reactor. Cole, Wiehagen, Vaught, and Mills (2001) examined simulations conducted in the U.S. Mining Industry. The miners in the program found that the exercises were interesting, relevant, helpful in learning to work with each other, and helped them to better recognize and prevent workplace hazards and injuries. Digital Game-
Digital Game-Based Learning provides a safe training regiment with a lack of dangerous consequences for mistakes.

Digital Game-Based Learning has established its place in training, being adopted decades earlier by technologically advanced militaries and big corporations. It is slowly entering the education field. The estimated time for education to adopt game-based learning is two to three years in the future (Johnson et al., 2010). The future holds a great deal of promise for digital games. Prensky (2001) predicted that the future of digital games would include features that are more realistic to life, fully online, and more collaborative. Digital Game-Based Learning mimics how the brain functions, making it an effective method for teaching or training individuals. It provides collateral learning opportunities in its content; much in the same manner as young people learn in a media rich society. Outdated methods of teaching are no longer an effective means for teaching the 21st century learner. Current research supports that DGBL is a 21st century method of teaching a 21st century student. The theory of multiple intelligences suggests that humans learn information best while utilizing their preferred learning style or strength. Digital Game-Based learning offers a wide variety of learning opportunities for people in their desired manner of learning. Finally, DGBL provides a versatile, popular, and motivating approach to learning content in a simulated, safe environment.

Including DGBL in an educational setting is the next logical step to scrutinize its potential impact. Numerous resources exist to incorporate digital games into instruction. Measuring time-on-task behavior will determine if the digital games are providing students with information in a manner that keeps their interest during the lesson. Also, having students share their attitudes during game play will provide insight into whether or not DGBL is an instructional approach worth having in an educational setting.

**Methodology**

CES is a K-5 public school with self-contained classrooms. Grades 3 through 5 (ages 8-11 years) contain approximately 280 students in 12 different homerooms. These grade levels are labeled intermediate in Maryland schools. Technology classes at CES are classified as a related arts class (ex. Media, Art, P.E). Each homeroom attends one hour of technology class a week. Technology classes integrate technology into content areas such as reading, math, social studies, and science. The students in grades 3 through 5 were chosen to participate in the study due to their level of maturity. These students should provide more reliable data than primary students who may not have heard the terms focus or engagement. Also, students at this unique stage of their lives are brutally honest and tend to provide truthful, unclouded data. Finally, they also tend to have longer attention spans. Does Digital Game-Based Learning improve student time-on-task behavior in comparison to alternative instructional strategies in intermediate level students? Are students more engaged in Digital Game-Based Learning in comparison to alternative instructional strategies in intermediate level students?
DATA COLLECTION
The data collection process included two methods to test the research questions. Student attitudinal surveys and student time-on-task observations occurred during each lesson cycle. Each class within the lesson cycle explored identical objectives and lesson assessments. One class received an altered lesson utilizing a different instructional strategy, while the others utilized DGBL as its instructional strategy. All classes within the lesson cycle completed the attitudinal survey to rate their experiences focusing on engagement and enjoyment of the lesson. The survey was completed at the end of each lesson by both the experimental and control groups. One student table group was picked at random to be observed. The observations were used to record time-on-task behavior. Harris (1986) defined time-on-task behavior as any time a student had his or her eyes focused on a book, paper, or self-monitoring question card, had eyes closed or word covered and lips moving, was writing words, or was checking words. This method needed to be slightly adapted to accommodate the instructional elements in a technology classroom (ex. computer screen, LCD projection, class discussions, etc.). The observation time for each student was 120 seconds. A student group in both the control and experimental groups was picked at random, observed, and time-on-task behavior was recorded. Each group had their time-on-task behavior averaged together to determine if the DGBL or alternative learning strategy produced a higher table group average. The surveys were anonymous to allow students to express their opinions freely. Google Docs provided a tool for anonymous survey dissemination and collection. The attitudinal survey consisted of five questions. Each survey was tailored specifically for the game or activity.

Table 1: Student Survey Questions
1. Please choose the one your teacher tells you to.
2. What grade are you in?
3. Please rate on a scale of 1 to 5, with 5 being the most enjoyable, rate your experiences with the activity.
4. How focused were you on the activity?
5. Please add any comments you have about the activity.

Question 1 asked students to identify if they were part of the experimental or control group. Most students in the range of 8 to 10 years old have no understanding of the definitions of control or experimental groups, protecting the reliability of the study. Students at this age follow simple instructions and are satisfied with completing oral directions given during the survey. This question does not jeopardize the validity of the research data. Identifying control and experimental group members allows for easier sorting inside an extensive database of student responses. Question 2 asked about the student’s grade level to further separate and filter the survey results. Question 3 asked them to rate their experience playing the game or completing the task on an adapted Likert scale with 5 being rated as very fun to 1 being rated not fun. Ratings of 5 to 4 were considered favorable; ratings of 3 were categorized as neutral, while ratings of 2 and 1 were categorized as unfavorable. Question 4 asked students to rate their focus during the activity. Students had 4 options to choose from for this question: a) really focused, b) focused, c) paid attention a little, and d) did not focus on the game. Question 4 established
how the students believed they did in terms of time-on-task behavior and their level of engagement during the lesson. Question 5 was an open comment box to record anecdotal reactions and experiences. The accumulated comments were rated as positive, negative, or neutral and sorted into the proper category. Positive comments included such statements as: a) fun, b) cool, c) enjoy, d) awesome, or similar adjectives describing satisfaction with the digital game or instructional strategy. Negative comments communicated a flaw or weakness during the activity. Negative comments included such statements as: a) boring, b) too easy, c) not fun, or similar negative descriptors. A neutral statement consisted 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 includes: a) game was fun but too easy, b) computers are cool, c) no hangman, d) medium, or other descriptor demonstrating neutrality. The comments were separated by experimental or control group and the number of positive, negative, or neutral responses were compared to determine which group had the most positive comments. Students who rated a learning activity as a positive experience were assumed to be engaged and attentive to the lesson, supporting the banner questions.

Eight lesson cycles occurred during data collection. One student homeroom was selected to be the control group, while another was assigned to the experimental group utilizing DGBL during instruction. The class sizes were fairly consistent, providing comparable results.

**DATA ANALYSIS**
Students in both the experimental and control group completed an exit ticket survey. The survey consisted of 5 items. The first two survey questions collected demographic information to identify what group the students belonged to and their current grade level.

**Table 2: Group Percentages of Activity Enjoyment**

<table>
<thead>
<tr>
<th>Trials</th>
<th>Ratings Range</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1%</td>
<td>2%</td>
<td>3%</td>
<td>4%</td>
<td>5%</td>
<td>6%</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>Experimental</td>
<td>5 to 4</td>
<td>33%</td>
<td>92%</td>
<td>91%</td>
<td>82%</td>
<td>60%</td>
<td>37%</td>
<td>92%</td>
<td>64%</td>
</tr>
<tr>
<td>Control</td>
<td>5 to 4</td>
<td>35%</td>
<td>63%</td>
<td>78%</td>
<td>54%</td>
<td>21%</td>
<td>46%</td>
<td>50%</td>
<td>55%</td>
</tr>
<tr>
<td>Experimental</td>
<td>3</td>
<td>52%</td>
<td>8%</td>
<td>9%</td>
<td>4%</td>
<td>30%</td>
<td>37%</td>
<td>8%</td>
<td>15%</td>
</tr>
<tr>
<td>Control</td>
<td>3</td>
<td>43%</td>
<td>22%</td>
<td>22%</td>
<td>29%</td>
<td>32%</td>
<td>33%</td>
<td>38%</td>
<td>6%</td>
</tr>
<tr>
<td>Experimental</td>
<td>2 to 1</td>
<td>14%</td>
<td>0%</td>
<td>0%</td>
<td>14%</td>
<td>10%</td>
<td>26%</td>
<td>0%</td>
<td>20%</td>
</tr>
<tr>
<td>Control</td>
<td>2 to 1</td>
<td>22%</td>
<td>15%</td>
<td>0%</td>
<td>17%</td>
<td>47%</td>
<td>21%</td>
<td>12%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Question 3 asked students to rate their experiences while engaged in DGBL or an alternative learning strategy. The question used a Likert scale with 5 being a rating of very fun to 1 being not fun. The responses were calculated into percentages for the groups. For example, in trials #3, 91% of students in the DGBL group indicated a rating of 5 or 4, 9 %
provided a neutral response, and no students rated the experience as not fun. Six of the 8 trials showed a higher or equal percentage in the level of enjoyment while engaged in DGBL in comparison to an alternative learning strategy.

The results for question #3 were further quantified with a class mean score. 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 utilized a multimedia project. Multimedia projects have a tendency of being very popular amongst students. Students were enthusiastic about creating podcasts. The DGBL activity utilized a quiz format similar to a television show. The data suggests that the multimedia was more enjoyable for students than the quiz show game (see Table 2). The result of this particular trial demonstrates the high degree of motivation for incorporating technology into the curriculum and sometimes that technology is not DGBL.

Table 3: Class Mean Scores for Activity Enjoyment

<table>
<thead>
<tr>
<th>Trials</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>DGBL (Experimental)</td>
<td>4.65</td>
<td>3.72</td>
<td>4.36</td>
<td>3.65</td>
<td>4.0</td>
<td>4.4</td>
<td>3.38</td>
<td>3.18</td>
</tr>
<tr>
<td>Alternative Strategies (Control)</td>
<td>4.17</td>
<td>3.16</td>
<td>3.37</td>
<td>2.73</td>
<td>3.58</td>
<td>3.42</td>
<td>3.3</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Next, question 4 asked students to judge their focus during the activities. The question offered four choices for students to select from. The selections Really Focused and Focused were categorized as a positive response for this self-rating measurement tool, while Paid Attention a little and Did not focus responses were classified as a needs improvement in terms of activity attentiveness. Six of the 8 trials produced equal or higher self-rating scores for focus and attentiveness. Most of the trials produced high percentages of students with the belief they were focused during activities in both the control and experimental groups. Several different factors may impact the self-rating system, potentially skewing the data. These factors include: a) motivation to work on computers, b) the simplicity of being focused on a screen less than 3 feet from the student's eyes, and c) a deep-seated, subconscious urge to respond positively to a question pertaining to being focused during a lesson in school. Each of these factors existed in both groups. Results are still valid if the same obstacles and factors existed in both the experimental and control groups. Also, the alternative instructional strategies are researched and proven to educate students. The alternate strategies were engaging, interactive, and promoted collaboration. These positive results affirm that some instructional strategies are better than others. Great care and scrutiny must be taken to determine the most appropriate strategy for the content and the students.
### Table 4: Student Focus Self-Rating Percentages

<table>
<thead>
<tr>
<th>Experimenta l Group (DGBL)</th>
<th>Self-Ratings</th>
<th>Trial #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Really Focused &amp; Focused responses</td>
<td>83</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>81</td>
<td>95</td>
<td>84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paid attention a little &amp; Did not Focus responses</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>19</td>
<td>5</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Group (Alternate Strategies)</th>
<th>Self-Ratings</th>
<th>Trial #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Really Focused &amp; Focused responses</td>
<td>96</td>
<td>100</td>
<td>100</td>
<td>78</td>
<td>89</td>
<td>96</td>
<td>92</td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paid attention a little &amp; Did not Focus responses</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>11</td>
<td>4</td>
<td>8</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The final question was an open comment box to collect reactions to the experiences in each group. Completion of the comment box was voluntary with students having the choice to skip this survey item. 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.

### Table 5: Open Comment Box Ratings

<table>
<thead>
<tr>
<th>Group</th>
<th># of Comments</th>
<th>Positive</th>
<th>Negative</th>
<th>Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group (DGBL)</td>
<td>144</td>
<td>111</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Class Percentages</td>
<td></td>
<td>77%</td>
<td>10%</td>
<td>13%</td>
</tr>
<tr>
<td>Control Group (Alternate Strategies)</td>
<td>120</td>
<td>77</td>
<td>27</td>
<td>16</td>
</tr>
<tr>
<td>Class Percentages</td>
<td></td>
<td>64%</td>
<td>23%</td>
<td>13%</td>
</tr>
</tbody>
</table>
Student observations were the final data collection tool used to evaluate time-on-task behavior in the control and experimental groups. Seven of the 8 trials produced higher group averages for time-on-task behavior 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 6: Student Table Observation Averages (in intervals of 120 seconds)**

<table>
<thead>
<tr>
<th>Trial</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental Group Averages</strong></td>
<td>97.16</td>
<td>120</td>
<td>113.6</td>
<td>116.6</td>
<td>114.16</td>
<td>104</td>
<td>114.8</td>
<td>116.25</td>
</tr>
<tr>
<td><strong>Control Group Averages</strong></td>
<td>73</td>
<td>113</td>
<td>115.6</td>
<td>108.6</td>
<td>101.2</td>
<td>89.2</td>
<td>75.2</td>
<td>86.8</td>
</tr>
</tbody>
</table>

**Conclusion**

The data from the study suggests Digital Game-Based Learning is a sound instructional strategy that promotes students engagement. The New Horizons Report (2010) suggests that DGBL will be adopted soon into many educational settings. It has a proven track record in the military and corporate sector. The adoption into mainstream education may meet with 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 supports that in these particular trials 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. Digital Game-Based Learning should be utilized in lesson plans where appropriate. Teachers should consider incorporating DGBL into instruction to provide a fun and engaging experience for their students.
REFERENCES


**APPENDIX - List of Digital Games**

(BBC) Dance Mat Typing – an online, interactive, flash-based typing tutorial for students. [http://www.bbc.co.uk/schools/typing/](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/](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](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](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](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](http://www.bravekidgames.com/flash_game_home_compost.php)


The Food Chain Game – create simple and complex food chains. [http://www.sheppardsoftware.com/content/animals/kidscorner/games/foodchaingame.htm](http://www.sheppardsoftware.com/content/animals/kidscorner/games/foodchaingame.htm)
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_salePopup.cfm

Grow and Learn – students learn fundamental aspects of gardening and raising plants by playing simulations games demonstrating gardening skills. http://www.growandlearn.org/


**Biographical note:**

Ryan Schaff is an Assistant Professor of Technology in the School of Education at the College of Notre Dame of Maryland and the Johns Hopkins University School of Education. He graduated with a Bachelors of Science in Education in 1999 from Towson University and his Masters of Science in Educational Technology from Johns Hopkins University in 2007. Current research interests include: Universal Design in Learning, Instructional Gaming, and 21st Century Learners.