Development and Preliminary Testing of Tablet Application to Increase Reading Motivation and Summarization for Adolescent Students with ADHD

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Joanne E. Pinna
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Joanne Pinna

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Abstract

Children with ADHD have a variety of difficulties with reading, including phonetics, reading comprehension, distractibility, lack of reading organizational skills and a low ability to summarize. This study created a tablet-based reading application designed to enhance their capabilities in developing a multimodal approach to reading. Participants who demonstrated difficulty in completing a reading task in a book exhibited a positive outcome on wanting to complete the reading and tasks in the application and complete their summary writing. The application encourages participants to read, answer questions about what was read about the text, record the answers, access notes written, and it aids in summarization of collected sequential information. A rubric score were used to compare summary writing differences after reading from the book and reading with the application. It was determined that there wasn't significant total score differences between the two, but the rubric score demonstrated areas of improvement.

Keywords: Attention deficit, application, test, read, summarize, multimodal

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Introduction

Students with attention deficit/hyperactivity disorder (ADHD) have a unique set of academic challenges. They lack the ability to sustain attention or focus. This affects them particularly in reading, writing, and summarizing skills, which are crucial to success in an academic setting. It is vital to understand these challenges and to investigate supportive strategies that address them. Studies by Raggi and Chronis (2006) have shown that use of computer technologies has a positive impact on students' reading skills. Assistive software may help students with ADHD retain focus in reading for longer periods. This study tests an intervention approach that may help students focus on these learning skills; by utilizing the application, students may develop skills to help them summarize what they read and develop a sense of achievement, thus enabling them to succeed in the academic setting.

Literature Review

Attention deficit-hyperactivity disorder (ADHD) is a condition in which individuals lack the capability of sustaining attention or focus. Symptoms of inattention and distractibility are key signs for ADHD and appear to be the most common component of the disorder. (Forster, Robertson, Jennings, Asherson, & Lavie, 2014). The disorder is usually confirmed in childhood; an estimated two to three out of 30 school-age children may experience it (American Academy of Child & Adolescent Psychiatry [AACAP] and American Psychiatric Association [APA], 2013). Three key traits common to students with ADHD are hyperactivity, impulsivity, and inattentiveness; individuals may have any one of these or they can have a combination of all three symptoms. Each category presents unique behavioral indications (National Institute of Mental Health [NIMH], 2012).

Children with hyperactivity predominantly show physical and action-oriented signals, such as fidgeting or squirming, continuous talking, an inability to stay seated, and distractibility. They have difficulty completing tasks that necessitate being quiet and sitting still, such as reading a book and or doing homework (NIMH, 2012). Impulsive students have limited self-control and a tendency to guess at answers rather than taking time to remember information or solve a problem (Diamond, 2013). Inattentive students do not display typical ADHD symptoms; they normally demonstrate reserved emotions. They usually sit quietly, not bothering other people, and are slow processors. They have the appearance of being consistently dazed, do not understand directions or tasks, and have difficulties organizing objects and thoughts. In addition, they often lose items (such as pencils, assignments, books), are easily distracted, and have trouble remembering information (Mayo Clinic, 2013). Such behaviors result in academic difficulties and poor achievement, disciplinary problems at home and school, conflicts with peers, and displays of emotional instability (Evans, Langberg, Raggi, Allen, & Buvinger, 2005).

Those with ADHD have challenges with reading, perhaps the most crucial skill in learning. By the time students enter the fourth grade, they are expected to have developed such reading skills as identifying cause and effect of story progression, identifying goals of characters, speculating about conclusions, and beginning to summarize the story as a whole (Westby & Watson, 2004). As these children become older, the level and intensity of their reading comprehension should increase. However, for those with ADHD, following the logic of a reading passage, remembering what is read, and being able to retell or summarize a story are extremely difficult. Consequently, while reading is the gateway to learning for most children and adolescents, it is a barrier for students with ADHD. So crucial are the skills of summarizing (such as retelling important parts of a story, including setting, characters, problems, and solutions

to support the main idea; describing what happens in the beginning, middle, and end of the story) that strategies to address and help students develop these skills are the key to their academic success.

Stern and Shalev (2013) conducted a study based on the relationship between continual attention and reading comprehension with children who had ADHD but did not have a reading disability. They found that children with high inattention performed at lower levels on reading tests compared to children who did not experience inattention. They concluded in their research, "The inability to maintain a relatively stable state of attention continuously impairs reading effectiveness" (Stern & Shalev, 2013, p. 438). Mahone (2012) found that individuals with ADHD often have difficulties in reading comprehension.

Barkley (2006, as cited in Johnson, Reid & Mason, 2012) considered short-term memory as a necessary skill in establishing links to reading different ideas or content presented in a reading passage. Barkley also found individuals with ADHD have reported that by the time they get to the end of their reading, they have forgotten what they have read. According to Numminen (2002),

> Memory and reading are in close interaction with each other. Insufficient working memory capacity or poorly organized long-term memory can cause, for example, difficulties with reading or reading comprehension. The target groups of plain language may have specific memory-related difficulties, which increase the challenge of reading (p. 1).

According to Wixson, Peters, Weber, & Roeber (1987), reading is the "dynamic interaction" of deciphering the information suggested by the text and the understanding and processing of information read in the text (p. 750). When reading, students need to use cognitive

resources to switch from deciphering text to understanding text. Students with ADHD have difficulty in making this adjustment; that difficulty slows the processes and interferes with the ability to comprehend (Barth, Catts, & Anthony, 2009). ADHD students also have difficulty with processing speed and reading fluency (the ability to process language for meaning) (Barth et al., 2009). Processing speed can be measured by a task called Rapid Automatized Naming (RAN). RAN measures the speed of orally repeating a series of familiar items with reasonable accuracy. The slowing of processing speed may influence efficiency of reading fluency, which can affect reading comprehension (Wolf & Katzir-Cohen, 2001). Stern and Shalev (2013) found that important processes involved in written expression are processing speed, working memory, language, and reading efficiency.

Students with ADHD have difficulty in completing long-term projects, such as reading a book (Mash & Barkley, 2003; Robin, 1998; Zentall, 1993, as cited in Raggi & Chronis, 2006). Their work productivity decreases, and they produce more errors the longer their attention is needed (Hoza Pelham, Waschbusch, Kipp, and Owens, 2001; Lorch, Milich, Sanchez, Broek, Baer & Hooks, 2000; Shelton, Barkley, Crosswait, Moorehouse, Fletcher, & Barrett, 1998; Zentall, 1993 as cited in Raggi & Chronis, 2006). According to Johnson, Reid, and Mason, (2012) "students with ADHD have difficulty sustaining attention on tasks and that can compromise the ability to focus on and comprehend reading passages" (p. 258). In particular, students with ADHD, when faced with tedious tasks, exhibit difficulty in maintaining effort and motivation (Fabio & Antonietti, 2012).

Links between memory function and processing in children and adults have been found to be highly specific. This is particularly true for reading complex and lengthy sentence constructions because comprehending long sentence structure must compete with retaining

information in working memory (Mann, Shankweiler, & Smith, 1984; McCarthy & Warrington 1987; Saffran & Martin, 1975 as cited in Willis & Gathercole, 2001). Willis and Gathercole (2001) in their research compared sentence recall with shorter sentences (7.8 syllables) to longer sentences (10.8 syllables) and found a higher performance, a 41% increase in recall ability, with shorter sentences. Because of working memory deficits and distractions, ADHD students have difficulty reading long texts; they tend to forget the main ideas behind the text, hindering their ability to write a summary of what they have read (Mahone, 2012). Since ADHD affects both low-level writing and complex text generation, it produces a heavier load on working memory, which then in turn produces a heavy impact on written expression performance. Thus, these deficiencies can produce multiple difficulties in the production of written language in adolescents with ADHD (DeBono et al., 2011).

ADHD students have difficulty processing information and remembering material. They also have conflicts when switching from reading to writing, whether it is to write down facts, produce an outline, or summarize a story (Westby & Watson, 2004). These deficits are directly associated with their ADHD-related executive function deficits (Mahone, 2012). Executive functioning refers to a set of intellectual skills a person needs to manage time, focus, plan, organize, remember, memorize, and integrate past knowledge with present events. These are the self-regulating skills needed in everyday life. Mash and Barkley (2003, as cited in Raggi & Chronis, 2006) noted that as many as 89 to 98% of students with ADHD exhibit deficits in executive functioning.

ADHD students show excessive difficulty managing time, organizing reading, memorizing, retrieving information, retaining information read, and completing work on time, all of which are basic executive function abilities. These abilities are complicated due to the loss of

focus, difficulty in concentrating on reading, and switching from one activity to another. Raggi and Chronis (2006) noted that organization related to performed actions relative to time fortifies forgetfulness.

Supportive Strategies that Help

Caretti, Re, and Arfe (2013) said that if information is presented in an organized structure and that attention is placed on providing prompts, such as titles and series of pictures, then poor readers improve their written summaries. They also suggested that readers must understand the goals of the reading in order to create a logical representation of text and help control the structure of planning. Readers must also produce, organize, write, and revise ideas to help with reading recall (Caretti et al. 2013).

Fundamental instruction should be given on emphasizing the relationship of story events. This process then aids students with ADHD to organize the structure of the story and to better understand and recall information (Berthiaume, 2006). Berthiaume (2006) said, “For example, a guide like story map that requires the student to fill in major events in sequence could assist him or her in connecting the events and solidifying the overall structure of the story” (p. 313).

Rogevich and Perin (2008) conducted a self-regulating strategy development (SRSD) study, which showed story writing enhancements to students who have emotional and behavioral disorders. SRSD involves giving clear instructions on using self-directed learning tools to build confidence and independence. One example of SRSD strategy is the Think Before Reading, Think During Reading, and Think After Reading (TWA) method, which aids ADHD students with comprehension. This helps students to recognize main ideas, reread events, and summarize the events to improve recall (Hedin, Mason, and Gaffney, 2011). Comprehension of vocabulary helps readers improve their reading fluency and understanding of language and text. Barth et al.

(2009) suggested that "infrequent presentations of a given word in text lead to strong representations of a word in memory," which helps guide students to reading understanding and comprehension (p. 586).

Students with ADHD have difficulty focusing on a large amount of information at once. Raggi and Chronis (2006) discovered that dividing academic material into smaller chunks of information or dividing homework into smaller units, which is referred to as "chunking," makes the workload appear more manageable. For ADHD students, it is helpful to break large bodies of text into smaller bits of information. The strategies of chunking include giving short concise directions, breaking up paragraphs, increasing white space, and using boldface or highlighted text to identify important information. Chunking focuses on the visual aspect of information and significantly helps students avoid cognitive overload. When focusing on only one aspect of a task, students with ADHD increase their productivity (Raggi & Chronis, 2006). Willis and Gathercole (2001) found a 41% increase in recall ability with shorter sentence structure. Huntley, Bor, Hampshire, Owen, and Howard (2011) conducted a study with participants who had Alzheimer's disease and found that chunking could extend working memory capacity. They proposed chunking as a major strategy underlying successful cognitive training in Alzheimer patients. Multiple studies have found that lessening the working memory performance significantly improved working memory capacity. Students with ADHD have difficulty concentrating, sitting still, and reading for long periods of time (Fabio & Antonietti, 2012). When information, such as reading, is presented in creative ways, such as in the form of videos, pictures, or as audio narration of small chunks of information, students have the tendency to pay greater attention and learn better (Fabio & Antonietti, 2012; Raggi & Chronis, 2006).

Raggi and Chronis (2006) noted that the combined use of several interactive media, including gaming, brought about addictive-like behavior in ADHD students, which in turn increased their attention. Fabio and Antonietti (2012) proposed that game-formatted information stimulates two different communication channels, the verbal channel and the non-verbal or visual channel. Interactive instructional tools create better learning outcomes and ADHD students reach success levels similar to those of typically developing students. Such tools provide students with concepts through such means as written text, oral narratives, pictures, animation, and sound (Fabio & Antonietti, 2012). Increasing the level of stimulation (such as adding color or novelty into routine tasks) can provide students with the motivation to continue reading (Kercood & Banda, 2012). Stern and Schalev (2013) revealed an increase in reading comprehension and sustained attention when presentation-type and text spacing were considered. Another positive finding regarding focus and attention comes from McClanahan, Williams, Kennedy and Tate's (2012) study on students' use of an iPad. They found that by using an iPad in a learning environment, students not only gained confidence because of self-control but also improved "one year's growth in reading" (McClanahan, et al., 2012). The iPad engaged the students in higher levels of stimulation, which may be lacking in the standard classroom setting. Another study concluded that by using an interactive medium called Kurtzweil computer learning software, students showed better focus on reading for longer periods, read with less tension and tiredness, and demonstrated reduced distractibility (Hecker, Burns, Elkind, J., Elkind, K., & Katz, 2002).

Positive reinforcement by giving rewards or setting goals, such as distributing points, coins, or other stimuli, has also been proven to encourage students with ADHD (Raggi & Chronis, 2006). Other reinforcement can include frequent and immediate feedback, which

improves students' goal-setting achievements. This emphasizes performance and encourages students to pay attention (Raggi & Chronis, 2006). Using note taking and providing students with an outline framework have been shown to stimulate students' attention and to facilitate the transfer of information into long-term memory (Gleason, 2012).

Methodology

Design of Application

The iPad application for this study was designed with the hypothesis that the participants would prefer the application and/or its features and would be encouraged to use the above outlined strategies built into the application. An iPad was used in the initial design because McClanahan, Williams, Kennedy, and Tate (2012) found that the iPad engaged the student in higher levels of stimulation not found in a normal classroom setting. The presentation of text was chunked so the student was not overwhelmed when he/she was reading. Raggi and Chronis (2006) discovered that "chunking" material into smaller units makes the workload appear more manageable. The application also reinforces Fabio and Antonietti's (2012) research which was to present learning in different formats, to have students pay greater attention and learn better by having the built-in ability to let the student read text on the page, listen to an audio of the text, or view a video of the author reading the text. A timeline was created so the student could track his/her progress toward completing the assignment (see Appendix A) to help them manage time to enforce executive functioning skills (Mash and Barkley as cited in Raggi & Chronis, 2006). Radio button questions (see Appendix B) pertaining to the text were added to every page to test Kercood and Banda's (2012) method of increasing levels of stimulation to motivate students to continue reading. The application also has the built-in capability give immediate feedback to correct or incorrect answers on the given pages (see Appendices C and D), which improves students' goal-setting

achievements, according to Raggi & Chronis (2006). Reflecting the findings of Caretti, Re, and Arfe (2013), images of the title and author (see Appendix E) were placed on every page to provide visual reinforcement of information. The application also provides a "Take Hint" button (see Appendix F) to highlight a certain section of the reading to prompt the student to re-read the information if the incorrect answer is given. This feature was adapted from the Think Before Reading, Think During Reading and Think After Reading (TWA) method to improve recall. Once the student completes reading or listening and answering questions, the final stage of the process in the application is for the student to write a summary of the text read. On this final page (see Figure 1), the correct answers that the students chose populate in a box next to the summary page. This feature supports the work of Berthiaume (2006), who found that organizing story events in sequence solidifies the structure of the story and leads to a strong picture in memory.

Figure 1: Summary Page of Reading Passage

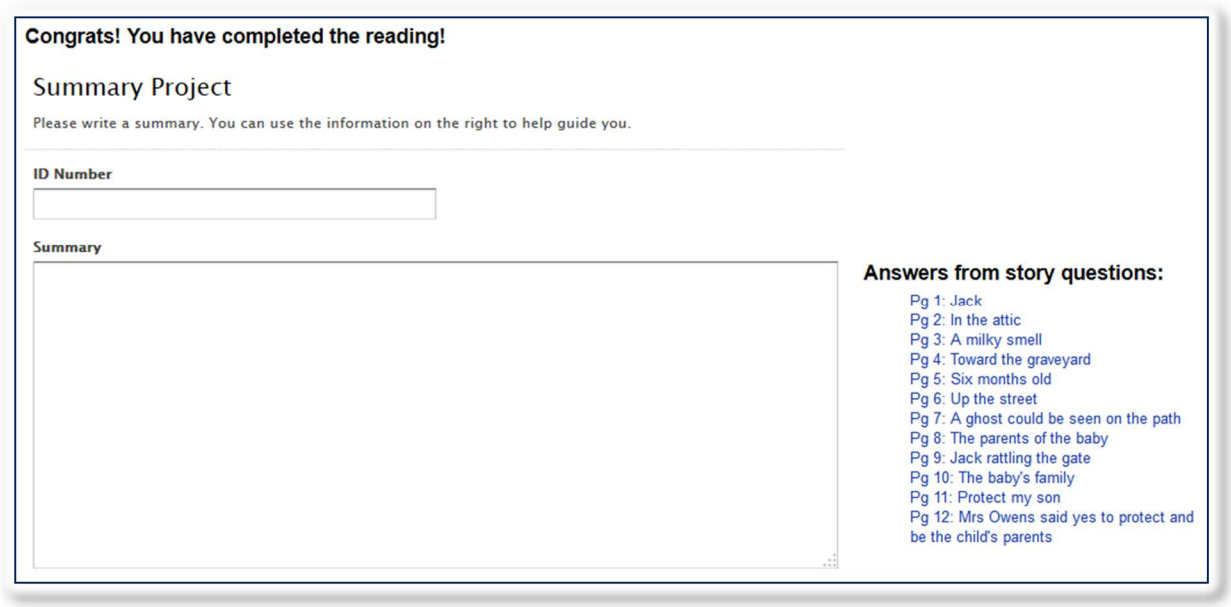

Figure 1. On the summary page of the selected reading, correct answers appear on the right, offering clues to the events in the story. This should help students in writing a summary.

Participants and Testing Protocol

All participants were recruited from a private school in the northern Baltimore area. The school offers individualized instruction to more than 100 students each school year. It serves students in kindergarten through ninth grades with dyslexia, attention deficit, and language-based learning differences and helps students gain the skills and self-confidence they need on their academic journey.

To be eligible for this study, the participants needed to have been identified with the diagnosis of ADHD by a psychiatrist, psychologist, or physician. The researcher contacted teachers whose students qualified for the study and explained the research project and a proposed projected time needed to complete the study. Within the group recruited, students from a variety of reading levels were included in order to get a varied sample of the population for which this application was designed.

The parents of the participants as well as the students themselves volunteered to take part in the study and were asked to sign consent and assent form. Twenty students' parents received several letters and forms from the school. Out of the twenty students, nine volunteered to participate. The participants consisted of seven males and two females, and the grades varied from seventh to ninth. The school was asked to confirm each student's age and reading level. The participants had reading levels ranging from fifth grade to ninth grade (see Figure 2). The participants were informed they could choose to stop the study at any time. Participants could choose to receive five-dollar gift cards to Target or either book read in the study as compensation, once the study was complete.

Figure 2: Reading Levels

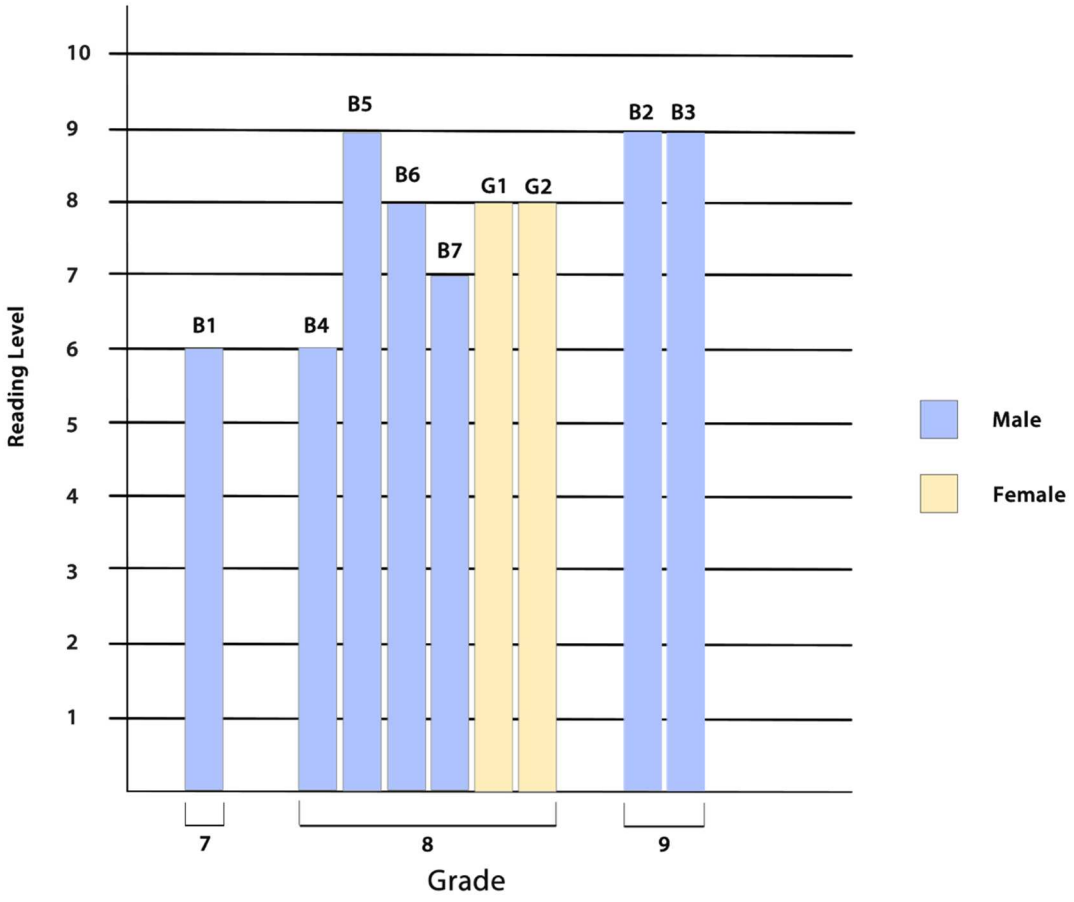

Figure 2. Depicts reading levels, which grade the participants are attending an their gender.

An introductory cover letter was sent to the eligible participants' parents from the school explaining the research project (see Appendix G). A brief informational letter was sent explaining the research process. A parental information/consent form was also sent to parents to sign acknowledging they understood the process and consented for their children to take part in the study: "Parent Information Statement" (see Appendix H). A student information/consent form was sent to the participants thanking him/her for participating "Student Information Sheet" (see Appendix I). The parents and the students were assured that their identity would be kept

confidential and would not in any way be revealed. Boy 1 (B1), Girl 1 (G1) and so forth will identify the students in this paper.

In the room where the testing took place, the desk faced a solid wall to minimize distraction. A camera was placed to the right of the student to record his/her completion of tasks. Each student took the book reading task and the application reading task on separate days. If students were given part 1 (book) at 9:00 a.m., they were also given part 2 (application) at 9:00 a.m. There were two instances where the time was not consistent. The fire alarm sounded for one student in the middle of reading the book, which caused a great distraction, and on another day, a student needed to take an exam, which postponed the reading of the application to a later time the next day. The book and the application were similar in reading level and word count. On day one, each participant read two chapters of a book. He/she was supplied with pen, pencil, a story-mapping sheet for note taking, and five sheets of ruled paper for summary writing. On day two, the student was instructed to read text with a similar number of words from the iPad application. The application contained an introductory page explaining the layout of the application. The different sections of the application were explained to the student to minimize the stress of learning a new application (see Figure 3). After the explanation, the students were asked if they had any other questions prior to beginning reading.

Figure 3: Application Explanation

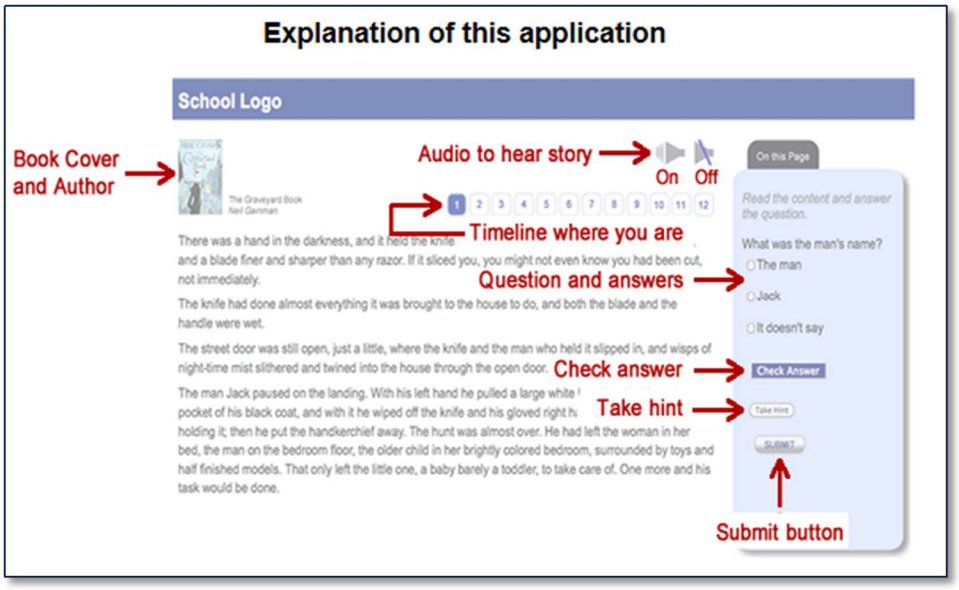

Figure 3. Depicts all the features available on the application.

The researcher told participants they had a choice in the application either to listen to an audio version of the story or to read the text. She explained that they needed to read the question on each page about what they had just read. They were then to answer the question on each page and check their answer to be sure it was indeed correct. They could also choose to use the "Take Hint" button on the application. The "Take Hint" section highlighted the area where the answer could be found. It did not give a direct answer to the question but directed participant to where the answer could be found. Once these steps were taken and the correct answer was chosen, they could submit the information and move to the next page.

Measures

This study required measurements of time. The first measurement was determining the total time to complete the reading. The second was calculating time for distractions. The final

time calculation was subtracting total time with distractions time and getting the new results of the total time concentrating on the reading. Time and focus are of importance; as stated above, Barkley (2006) (as cited in Johnson, Reid & Mason, 2012) found individuals with ADHD forget what they have read at the beginning of a story by the time they get to the end. Two stories were chosen, one for the application and one for the book, and both were written for middle school students, rated on the same reading level, and had approximately the same amount of text. Both books are from the reading list of the school system in Harford County, MD.

A concept model was designed (see Appendix J) to simulate the theory being tested that the application helps the participants attain a higher rubric score in summary writing than just reading a book and that time and focus influence the relationship between the application and the increase of rubric scores. Total time spent reading the story in the book was compared with total time on the application. The researcher reviewed the recording of the participant and observed time spent focusing and time spent distracted. An observed time count was recorded when the participant either looked up or away from the reading. A Panasonic video camera with a time stamp was used to capture and record the number of breaks in attention. This is similar to the study by Bunce, Flens, and Neiles (2010). They measured students' attention lapses or frequency of breaks in attention by asking students to use "clickers." The students reported these lapses by pressing three different buttons on their clickers, with each button representing a different measure of time of one minute or less, two to three minutes, and five minutes or more. In this study, breaks in attention were visually observed and noted when the participant would look away from the reading. These breaks in attention were measured in length of time of inattention calculated in tenths of a second.

Summary writing was measured by the use of a rubric developed by the researcher for this study (see Appendix K). A rubric is a tool often used by teachers for qualitative and meaningful interpretation of students' performance. A rubric measures the ability to retell the story in the participant's own words or to summarize the main idea of the readings. A rubric is the comprehension assessment most commonly used to test reading skills. A single rubric was designed by the researcher to compare the summary writing on the application to the summary writing from reading the book. The intention of this rubric was to assess the number of components of the reading recalled and the completeness of the summary of the stories. The scoring rubric contained eight categories in which a score of 1 to a maximum of 4 points per category was possible to obtain for a comprehensive story summary. For example, in the first row of the rubric, a total score of four was possible if the participant mentioned the books' or applications' story title and/or author. The other rows in the rubric consisted of assessing the accuracy and completeness of the participants' summary in regard to the Setting, Characters, Problem, Conflict, Accuracy of Facts, Organization, and Action Verbs used to describe the story. Depending on the level of information given in the summary, a minimum of eight points could be achieved to a maximum of 32 points (see Appendix K). This particular rubric had never been tested prior to this study. In order to validate a rubric's outcome, it should be assessed several times to assure the learning outcomes are constant.

At the end of the study, each participant was then asked to partake in a survey regarding whether he/she liked using the application and how he/she liked using the application compared to reading book. The survey consisted of ten questions. The first question was to identify the participant and the second to verify the date. Questions three through ten were specific to the participants for quantitative and qualitative data about the application (see Appendix L).

The participants were also verbally asked several general questions on how they felt about the reading chosen both of the book and the application. The questions were:

1) Did you feel the book was difficult to read?
2) Did you like the story?
3) Would you like to continue reading this book?
4) Was the reading too long?
5) Do you feel you needed a break during the reading?

These questions were to verify to the researcher that chosen readings did not cause any stress to the participant because of being too difficult to read.

Results

The application was developed to provide a means for students of middle to high school age to recall sufficient information to write successfully a comprehensive summary of what they have just read. The study examined whether time and focus have a direct influence on summary writing, whether the application use leads to a better rubric score in summary than reading the book, and whether the participants prefer reading from the application compared to the book. This study also demonstrated which built-in strategies the participant most frequently used.

Time/Focus Results

A video camera was used to record the date and time stamp of the participant's use of the book and application. Both the book and the iPad for both days were placed on the desk in front of the student. Also on the desk for the book-reading task were several story mapping sheets for note taking and five blank ruled pages for their book summary writing. Interestingly enough, all the participants instinctively either picked the book up in their hands to read or held the book in

some way. However, when introduced to the iPad, none picked it up or held it. It must be noted that the iPad was plugged into the charger with an extension cord while being used. The cord was long enough for the iPad to be picked up.

Book.

When utilizing the book, the recording began once the participant sat in the chair and instructions about the reading task were explained. The instructions indicated that the student needed to read the book until the end of the second chapter, which was signaled by a bent corner of the page. The students then were told they were allowed to go back to the reading if it helped them to take notes or write the summary. The recording would then end after the summary writing task was complete. Once the participants began reading the book, their body position changed several times but they continued to read, surprisingly with minimal focus distractions. They were very attentive in their reading. Only one participant said he could not read anymore because he was tired, and he did not complete the two chapters. Another student exclaimed she had a hard time reading the book because an opened book with the text on both sides is very overwhelming to her.

Application.

The next day, for the application, the recording again began once the participant sat in the chair and prior to the explanation of using the iPad. The applications' first page identified the participant by number. The second page contained the image of the various parts of the application (see Figure 3) and the instructions for the iPad were explained here. They were also instructed not to move on to the next page until the "Check Answer" button revealed they had chosen the correct answer (see Appendix M). They were then asked if they had any other questions about the application. The third page gave the participants a choice of eight different

avatars for them to identify with. The avatar choice in this study is not very significant part of this study. However, if this application would be built for longer-term use, the avatar feature would help the student in self-recognition, especially if there would be multiple users on the same device. The fourth page displayed the book title, author and the book cover image. The participants were required to click on the book to reinforce the visual aspect of what they were reading. The fifth page had directions about the reading. Five out of nine students read the directions. The other participants skipped the directions, clicked the submit button and began the reading. The sixth page is where the reading began. The timeline at the top of the page displayed they were on page one of twelve in the reading. On the first page of the reading, some participants were hesitant in using the application. Once the initial reading page was complete, no one had any difficulty or confusion on how to use it.

Five out of nine participants chose to read the story on the application. Three chose to use the audio capabilities and one participant began reading the story, however, ¾ of the way through chose to listen to the audio. Most of the participants who decided to read the story, read the whole page then read the question, and began the process to see if the answer was correct or not. Most of the participants, who decided to hear the audio, while they were listening to the story, began to glance over to the question and begin searching for the answer, while the audio was still playing. The participants when clicking the "Check Answer" button, receiving the message they had chosen the wrong answer, quickly understood the "Take Hint" button would direct them on the paragraph that contained the correct answer. Four out of the nine participants used the "Take Hint" button, and it was activated twelve times. One participant used this particular function twice to get the correct answer. If they answered correctly on their first

choice, most exclaimed, “Yes!” or “Yea” under their breath. One participant even exclaimed, “This is great! I love it.”

Looking at the below chart (see Figure 4), the majority of the participants took less time reading in the application than reading the book. For three participants it took more time to complete the reading from the application, and it needs to be noted that all three used the means of listening to the audio. However, in the visual observations, focus was more intense when participants were holding the book to read, while fidgeting increased and less focus were seen when they were reading with the application. Surprisingly, time and focus reading the book compared to time and focus reading from the application did not show any direct influence on the summary writing.

Figure 4: Time Reading Book and Application

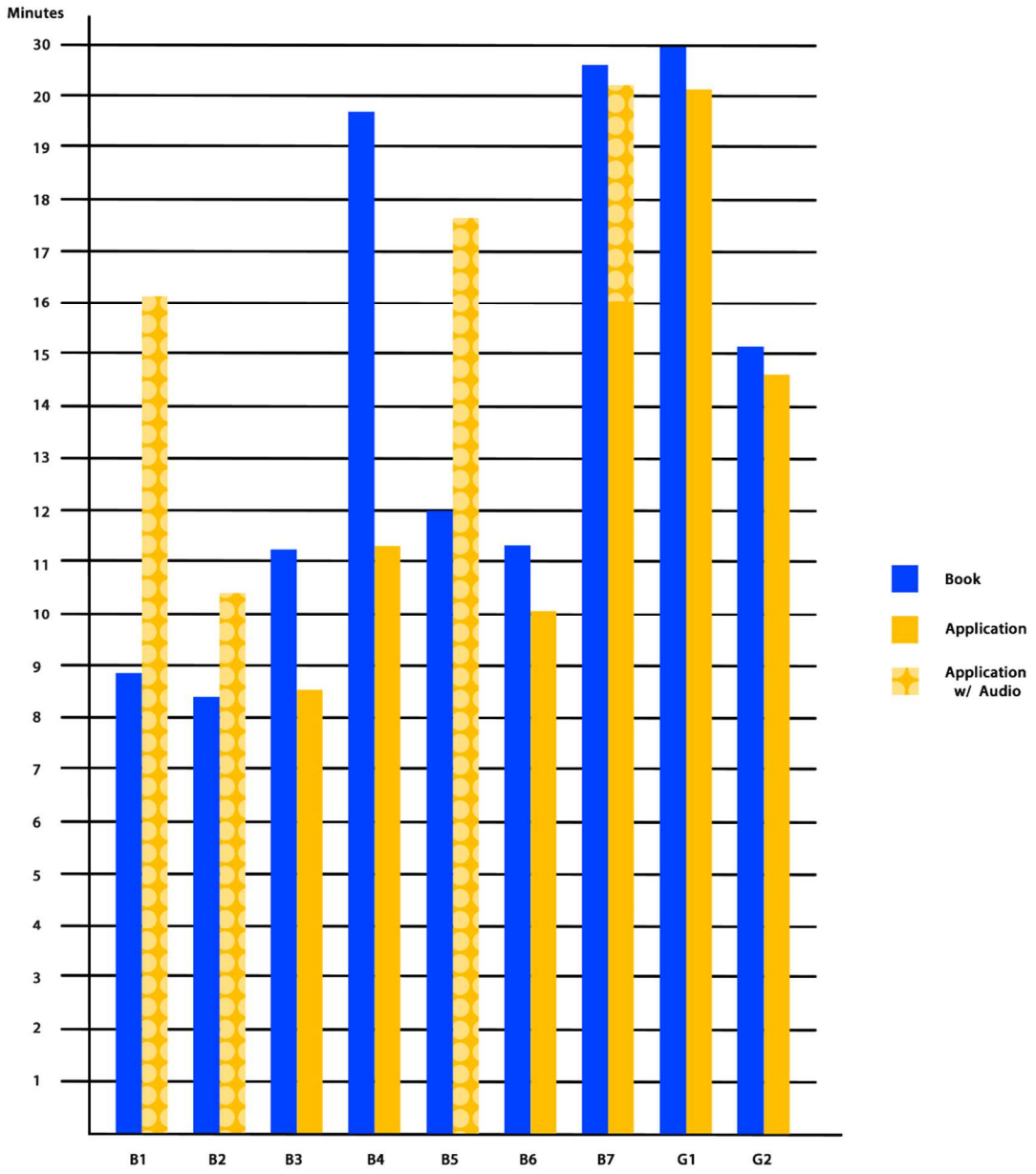

Figure 4. The above graph compares reading time in the book and the application. It also shows if they used the audio feature.

The above graph (see Figure 4) also shows the association between the times participants took to complete the book and complete the application. There is not a clear association for all

students. Participant B2 and B3 took a relatively short time on both, and participant B7 and B8 spent a long time on both. However, participant B1 took a long time on the Application (16 minutes) and a short time on the Book (almost 9 minutes). This information shows the diversity between students' abilities and reading speed participating in this study, which would be relevant to a "real time" classroom of students using this application.

Rubrics Results:

The outcome of this study was to determine if there were differences in percentages of summary writing from the book compared to summary writing from the application. All of the participants first read the book then on the next day read the story on the application. When looking at the rubric scores, only one student reading the book mentioned the author and title of the story. This was a surprising result, especially since in the application and image of the book and author was represented on every page. The setting and character recognition increased along with the organization of story events and using appropriate actions words to describe these events. However, the problem, conflict and accuracy of facts decreased in the scoring. Data for the total scores in the table (see Appendix N) shows four participant scores increased, three decreased, and two participants' rubrics scores stayed the same. However, the mean of the summary writing score stayed the same. The rubrics did not show better comprehension or better summary writing comparing the application to the reading.

This graph below (Figure 5) shows that there is an association between scores, regardless of the method used reading the book or application. For example, participant B4 had a low score (10) on both book and application, whereas participant B2 had a high score on both the book and the application (21). So it would appear that it is more a matter of differences of reading comprehension between students than differences between book and or application.

Figure 5: Total Scores Each Student

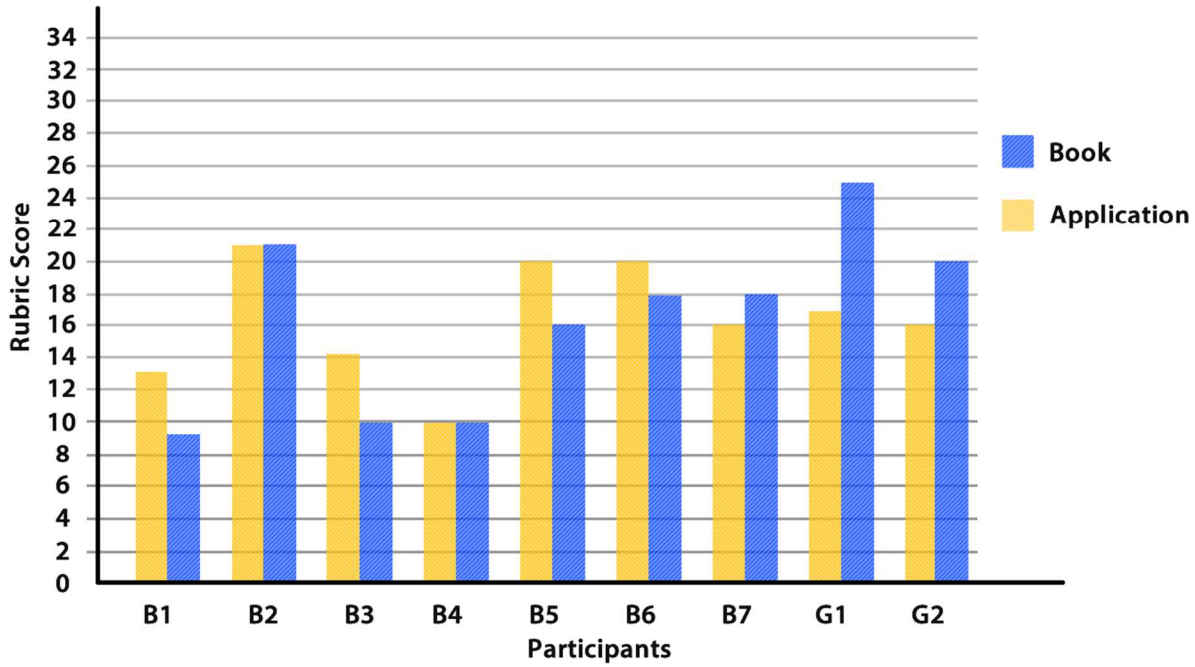

Figure 5. The above graph compares rubric scores of the book and the application for each participant.

Survey Results:

The survey consisted of ten questions. The first question was to identify the participant and the second to verify the date. Questions three through ten were specific to the participants for quantitative and qualitative data about the application (See Appendix I). The results were very positive.

In question three, "Which did you like reading more? The iPad or the book?" , 69% of the responses were the iPad; when questioned "Why?", one participant commented "I liked that on the iPad when I had to answer a question I could look right back on the page then on the book I would loose [sic] my place an[d] the[n] I would have to read the page all over." Five participants responded that having the audio feature was the reason they preferred the application.

Question five and six looked at why they liked the reading questions on the application. Four out of nine preferred the application because they found it easier to type on the iPad instead of writing on the paper. One claimed it was easy to push the buttons on the screen instead of writing it all out. One participant also claimed, "The iPad says right or wrong so but the book dose [sic] not do that."

In questions seven and eight, the question was "Was it easier to write a summary of the story using the iPad or on paper?" and why. Majority of the participants restated it was easier to type than to write. Two participants claimed it was easier to remember.

Overall 84% of the participants indicated on the survey a preference for the iPad application. Even though three participants (B1, B2, and B5) took longer to read on the application than to read the book, they had several positive reactions to the application. Several students explained their preference for the application. Another stated, "The iPad you can press a speaker button to read to you but you can't do that to a paper book." On question 10 ("How did you like using the iPad for reading?"), 84% stated, "Liked it very much."

Discussion

This study investigates student preferences for an application that is equivalent with the supportive strategy studies that may help students write a comprehensive summary of what they read, develop a sense of achievement and enabling them to succeed in the academic setting.

There were a few setbacks in the design and results of the application. The application was designed to offer the option for the student to view a video of the story. In this particular school, security settings prevented access to the video component. Therefore, this option was removed from the application and not tested. It would be beneficial to have the video option on future testing to see if the participants have an interest in using it.

Nine middle school participants with varied reading levels and diverse abilities tested the application and the design of the application was based on strategy theories that help ADHD students. The rubrics scores, which were highly anticipated to show a great deal of difference between the book and the application in this study, showed no differences. Although the rubric scores did not indicate the differences as expected, there could have been some contributing factors to these results. For instance, nine participants is a small sample size, which could have contributed to the inconclusive outcome. In addition, the rubrics had not been previously tested, therefore it is possible the level of probability on this particular sampling was too rigid. Also, the rubrics were not previously presented to the participants; in turn, they were not informed of the researcher's expectations and of the scoring process.

It was apparent that once the students, especially the ones who used the audio feature, understood how the application functioned, they were more inclined to look away from the reading and anticipate the answer prior to the completion of the audio. However, having the ability to have an audio button, to the students who used it, found the audio function a profound feature. One participant asked, “Am I allowed to listen?” The researcher then responded, “Sure”. The participant then said, “This is awesome. I already like this better than reading!” A possible improvement to the application would be to not have the questions appear until the reading is complete. Altering the availability of the questions could reduce or minimize these distractions.

Students when handling a book showed less distractions and fidgety body movements then when using the iPad, which is in contrast to the theory results of Hecker, et. al. (2002), which demonstrated reduced distractibility. Possibly handing the iPad to the participant or not having the iPad plugged into the charger, might encourage the handling of the iPad like a book, which in turn also may reduce the excessive fidgeting and loss of focus. Another possible feature

to the iPad to enhance the feel of a book would be a textured cover to sense more like a book. Further testing with these scenarios would be necessary.

Even though there were some setbacks in the summary scoring results, there were many positive features to the application. One student who took the longest time to read in the book and listened to the audio in the application, could not finish reading the two book chapters; however, he did succeed in finishing the comparable amounts of words in the application, which is in direct affirmation of Fabio & Antonietti's (2012) and Raggi & Chronis' (2006) studies that with audio narration of small chunks of information students have the tendency attain greater attention.

Another encouraging attribute was the highly used "Take Hint" button. The participants repeatedly used this feature to help them make the correct choice in answering the questions. One participant stated "When I had to answer a question I could look right back on the page then on the book I would lose my place and then I would have to read the page all over again." This is similar to from Hedin et al.'s (2011) study, which showed rereading events improved recall. All the participants demonstrated excitement when receiving immediate feedback in choosing the correct answer. This echoes the results from Raggi & Chronis' study (2006) indicated that immediate feedback improves students' goal setting.

Conclusion

Students with ADHD lack the ability to sustain attention or focus that affects their reading, writing, and summarizing skills to succeed in an academic setting. This research project took a close look at different supportive strategies that help ADHD students have a positive impact on summary writing. An application on the iPad was built that closely reflected these positive strategies, presents these strategies with a new concept and an alternate format of

learning for students. Essential design functions in the applications consisted of having the iPad as the medium, clear instructions for self–directed learning, fundamental instruction emphasizing story events, presenting information in an organized structure, providing prompts such as titles and pictures, note taking during the reading, reading presented in creative ways such as videos, pictures, audio and interactive media, chunking of information in text and audio, using novelty into tasks, and positive reinforcements for immediate feedback. Most of these features have shown in this study a positive outcome on having the student wanting to complete the tasks in the reading application and complete their summary writing. One example is a student who had extreme difficulty to continue reading the assigned book showed determination in completing the reading with positive results in finishing his reading and his tasks in the application.

In this study, contrary to common belief that focus and attention would be greater using an iPad, the students exhibited more fidgeting and body movement with the application than with the book. Possibly in subsequent studies it might be beneficial for the iPad be handed to the student instead of being laid on the desk or even having the iPad covered with similar texture as a book so that the students would want to handle the iPad.

Some future design changes in the application would be switching the type of questions (Figure 3). Some question information could be presented in a way such as having a matching or fill in the blank to keep the motivation up and presentation of information in multiple ways. Refinement of the questions pertaining to the text and producing comprehensive answers on the summary page could indeed help the students improved recall information to write a more complete summary. Creating a stronger rubric and presenting and reviewing the rubric to the participants might enhance the scoring of the summary writing. This research would benefit

greatly by having more participants partake in the study to gather more conclusive data and take a better look at the reading results.

At the moment there are very limited support applications for middle to high school students with ADHD. This research study demonstrated many positive attributes, which are imperative that this application continues to be tested and further developed as a means of student learning intervention.

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Appendices

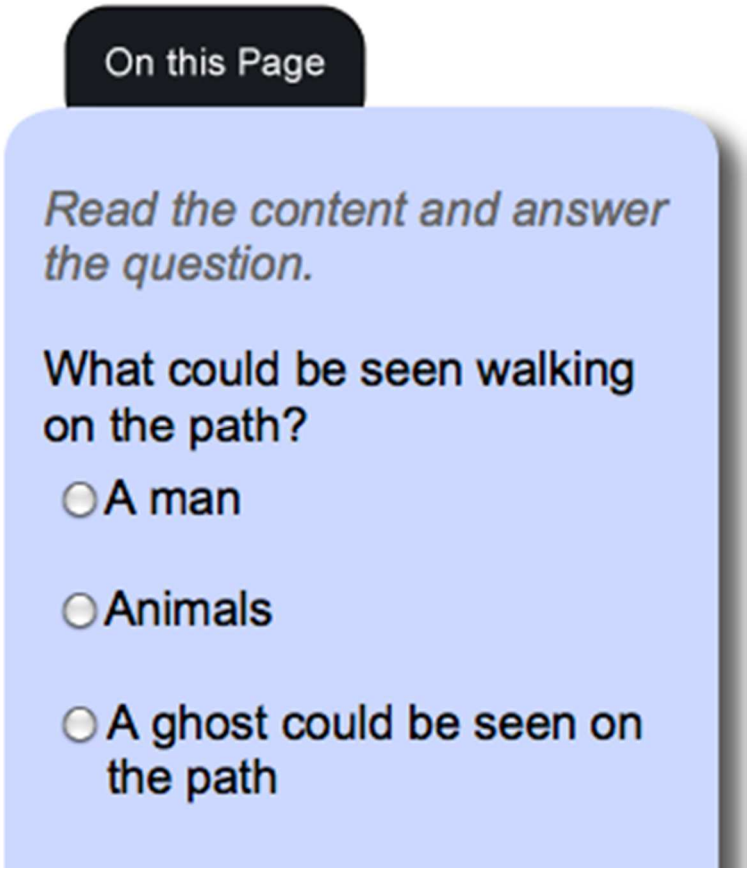
Appendix A

Application Timeline

Appendix A. This is the timeline to show students progression in the application

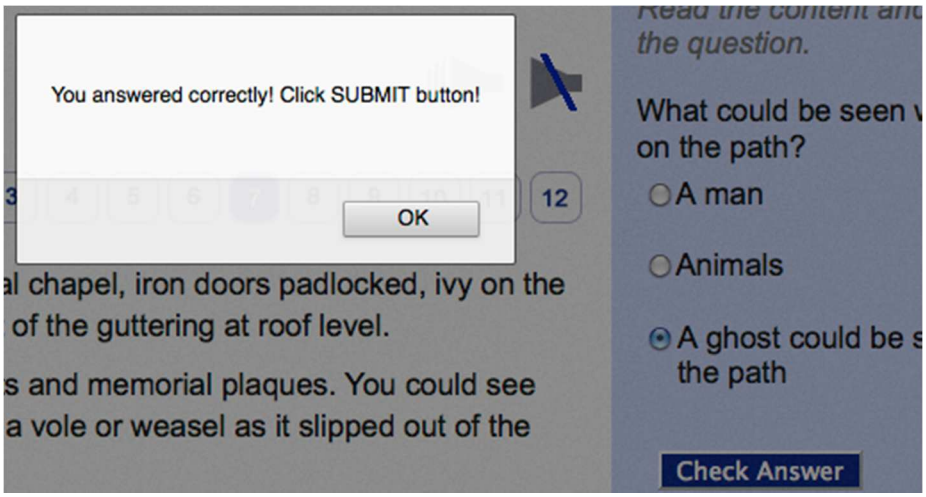
Appendix B

Application Radio Button Choices



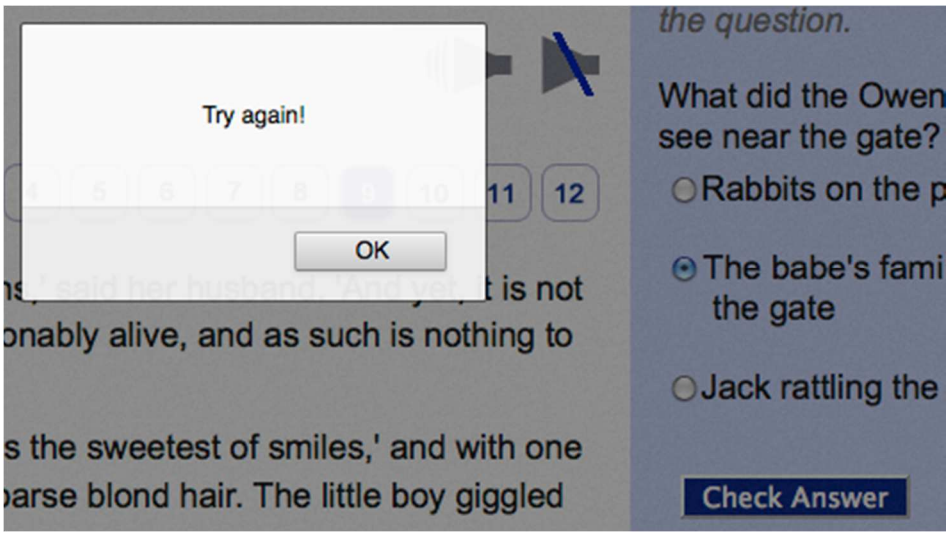
Appendix C

Application Positive Feedback



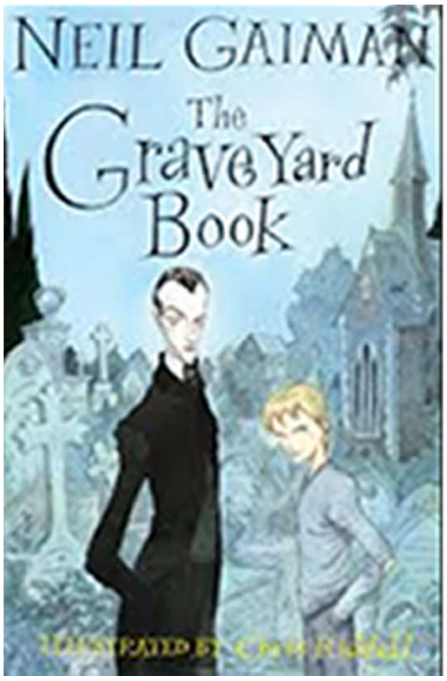
Appendix D

Application Positive Feedback



Appendix E

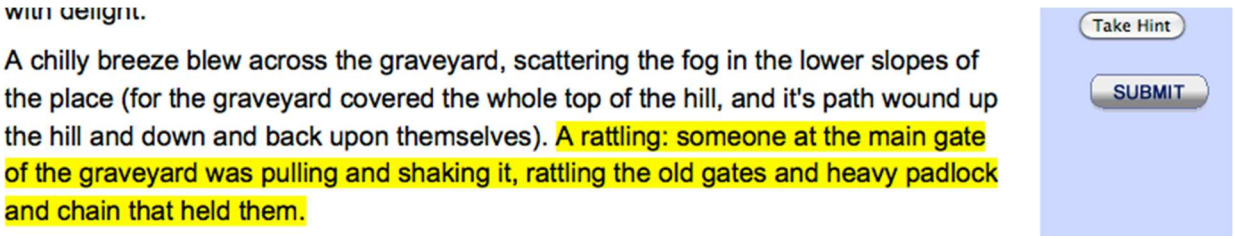
Application Image of Title and Author



The Graveyard Book
Neil Gainman

Appendix F

Application Take Hint Button and Highlighted Area



Appendix G

Introductory Letter

Cover Letter to Parents

Dear parents,

I am a Master student in Interaction Design and Information Architecture (IDIA) program at the University of Baltimore. I am writing to let you know about an opportunity to participate in a small research study. The study involves an iPad application I built for children with ADHD to compare reading and summarization on the created application with reading and summarization from a book.

The story in the application will be similar in text, length and reading level as the story in the book. The research will be conducted with 20 participants in the middle and high school range.

This application if successful in its research findings may possibly help other students with ADHD to successfully summarize what they read.

I will be the principle investigator joanne.pinna@ubalt.edu, phone 410-706-8849 for the project under the guidance of Dr. Lucy Holman lholman@ubalt.edu, phone 410-837-4333 at University of Baltimore. The project is also under the supervision of UB's Institutional Review Board. For more information you may contact them at irb@ubalt.edu.

Thank you in advance for giving permission to begin this study.

Joanne Pinna

Appendix H

Parent Consent and ADHD Verification

University of Baltimore

Parental Information Statement

1. **What is this study about?**

   Your child is invited to take part in a research study to test an iPad application designed to increase reading motivation, focus, and summary skills for adolescents with ADHD. Please read this sheet carefully and ask questions about anything that you do not understand.

   The inclusion criteria for this study are adolescents diagnosed with ADHD by pediatrician or psychologist. This Parental Information Statement describes the research study. Knowing what is involved will help you decide if you want to let your child take part in the research.

   Your child's private information will not be disclosed nor will the private information be shared with other individuals outside of the study.

   Participation in this research study is voluntary. By giving your consent, you are telling us that you understand what you have read and that you will allow your child to take part in the research study as outlined below.

2. **What will the study involve?**

   The purpose of the study is to evaluate a program application for children with ADHD. The iPad application will compare reading/focus and summarization on the application to reading/focus and summarization from a book.

   The location will be at your child's school. Your child's involvement in the study will be to read a chapter in a section of a story on the iPad application, answer questions about the story, and give a summary of what he/she has read. Your child will also read a chapter from a book, use note-taking strategies, and summarize what he/she has read. At the conclusion of the session your child will answer a questionnaire about what he/she liked and did not like about using the iPad application.

   Your child will be audio and video recorded while he/she is using the iPad and book. Your child's name, voice and video will not be shared to anyone outside of this study. Only data results from the study will be shared.

   Your child will not be identified during the research.

   Information collected in this study will be stored on a separate file drive and in a locked room. Only the principle investigator and members of the study team will have access to this information. If information learned from this study is published, your child will not be identified by name.

By signing this form, however, I allow the principle of this study make my records available to the University of Baltimore Institutional Review Board (IRB) and regulatory agencies as required to do so by law.

3. **Does my child have to be in the study? Can he/she withdraw from the study once it has started?**

If you decide to let your child take part in the study and change your mind later (or he/she no longer wishes to take part), you and your child are free to withdraw from the study at any time. You will just need to inform the instructor. To thank your child for completing the study, he/she will be able to choose to receive a copy of the book they read in the study or a five-dollar gift card to Target. This iPad application, if successful, may help other children with ADHD to successfully read, take notes, and summarize what they have read.

4. **Please answer the following question to qualify for the study?**

☐ Yes I would like my child to take part in this study
☐ No I do not want my child to take part in this study
☐ My child is diagnosed with ADHD ☐ My child is not diagnosed with ADHD
☐ My child was diagnosed by a pediatrician ☐ My child was diagnosed by a psychiatrist

5. **Principal Investigator Information**

The principal investigator, Joanne Pinna, has answered any and all questions regarding my child's participation in this research study. If I have any further questions, I can contact Joanne Pinna at:

joanne.pinna@ubalt.edu
Phone: 410-706-8849
or

Thesis advisor:
Dr. Lucy Holman
lholman@ubalt.edu
Phone 410-837-4333.

For questions about rights as a participant in this research study, contact:

University of Baltimore IRB Coordinator
jklucar@ubalt.edu
410-837-6199

6. Signature for Consent

I give permission for my child, _____, to participate
(Name of Child)
in this study.

Parent/Legal Guardian's Signature _____ Date _____

Child's Participant Name _____ Date _____

Appendix I

Participant Consent

University of Baltimore

Student Information Statement

1. **What is this study about?**

   Hello! You have been chosen to help in a reading and summary writing study. The purpose of this study is to see if reading from the iPad with a new app helps to write a better summery than reading from the book and you will help test your summary writing skills. You will begin this study when you agree to help and will finish helping until April 2015. About 8-20 people will be also invited to help.

   Your private information will not be shown nor will any private information be shared with other individuals outside of the study.

   Volunteering in this research study is up to you. By signing this paper, you are telling us that you understand what you have read and that you would like to take part in the research study.

2. **What will the study involve?**

   You will need to read a chapter of a story on the iPad app, answer questions about the story, and give a summary of what you read. You will also read a chapter from a book, use note-taking strategies, and summarize what you read. At the end of the study you will answer a questionnaire about what you liked and did not like about using the iPad application.

   Your will be voice and video recorded while using the iPad and book. Your name, voice and video will not be shared to anyone outside of this study. Only information results from the study will be shared.

   Your picture or name will not be identified during the study. You will be given a number to bring to the study.

   Information collected in this study will be stored on a separate file drive and in a locked room. If information from this study is published, your name will not be identified.

3. **Do I have to be in the study? Can I stop helping the study once I have started?**

If you decide to help in this study and change your mind later, you can stop helping in the study at any time. You will just need to inform the instructor.

To thank you for finishing the study, you will be able to choose a copy of the book you read in the study or a five-dollar gift card to Target.

4. **Please answer the following question to qualify for the study?**

☐ Yes I would like my help in this study
☐ No I do not want to help in this study

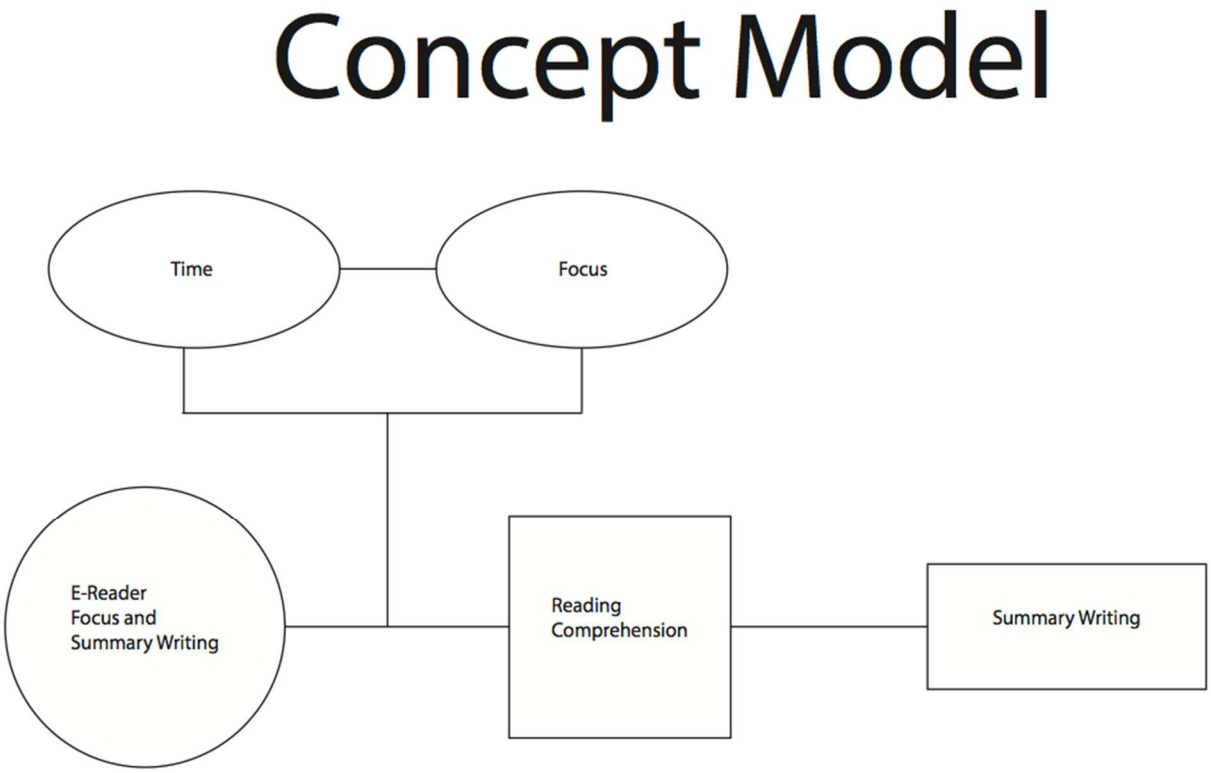
5. Signature for Consent

I _____, would like to help in this study.
(Name of Student)

Date _____

Appendix J

Project Concept Model



Appendix K

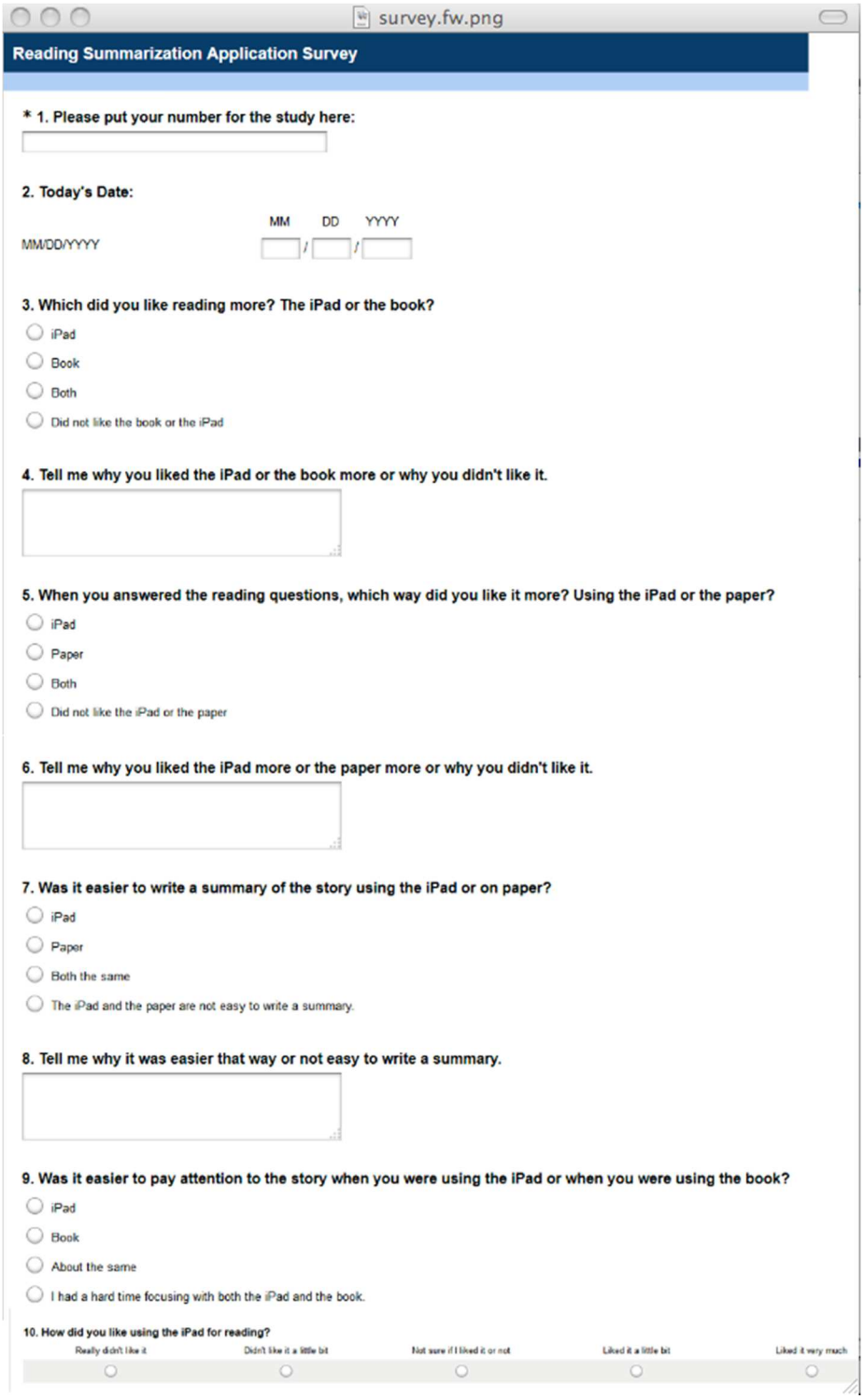
Book and Application Rubric

Researcher: Joanne Pinna
Student No:

CATEGORY	4	3	2	1
Title	Title is the same as story title	Title is related to the story and topic.	Title is present, but does not appear to be related to the story and topic.	No title.
Setting	Many vivid, descriptive words are used to tell when and where the story took place.	Some vivid, descriptive words are used to tell the audience when and where the story took place.	The reader can figure out when and where the story took place, but did not supply much detail.	The reader has trouble figuring out when and where the story took place.
Characters	The main characters are named and clearly described in text as well as pictures. Most readers could describe the characters accurately.	The main characters are named and described. Most readers would have some idea of what the characters looked like.	The main characters are named. The reader knows very little about the characters.	It is hard to tell who the main characters are.
Problem	It is very easy for the reader to understand the problem the main characters face and why it is a problem.	It is fairly easy for the reader to understand the problem the main characters face and why it is a problem.	It is fairly easy for the reader to understand the problem the main characters face but it is not clear why it is a problem.	It is not clear what problem the main characters face.
Conflict	Main conflict has been accurately identified	Main conflict has been somewhat identified	Main conflict is vague and unclear	Main content is not identified
Accuracy of Facts	All facts presented in the story are accurate.	Almost all facts presented in the story are accurate.	Most facts presented in the story are accurate (at least 70%).	There are several factual errors in the story.
Organization	The summary is very well organized. One idea or scene follows another in a logical sequence with clear transitions.	The summary is pretty well organized. One idea or scene may seem out of place. Clear transitions are used.	The summary is a little hard to follow. The transitions are sometimes not clear.	Ideas and scenes seem to be randomly arranged.
Action	Several action verbs (active voice) are used to describe what is happening in the story the story. The story seems exciting!	Several action verbs are used to describe what is happening in the story, but the word choice does not make the story as exciting as it could be.	A variety of verbs (passive voice) are used and describe the action accurately but not in a very exciting way.	Little variety seen in the verbs that are used. The story seems a little boring.

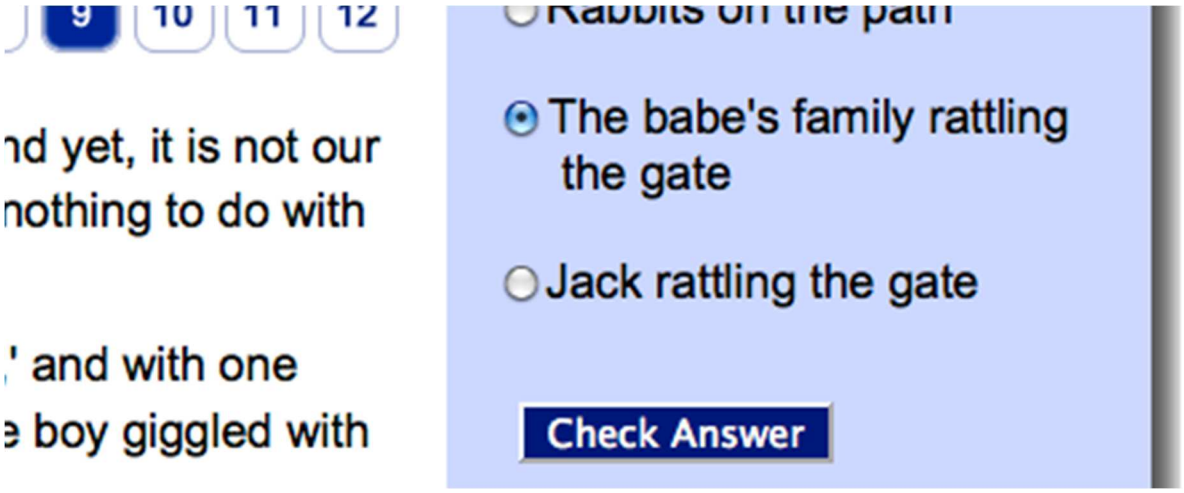
Appendix L

Survey



Appendix M

Check Answer Option



Appendix N

Book and Application Rubric Scores

Participant Rubric Scores: Point Range 4 – 1 Points Minimum 8pts - Maximum 32pts

Book

	Title	Setting	Characters	Problem	Conflict	Accuracy of Facts	Organization	Action	Total
B1	1	1	2	1	1	1	1	1	9
B2	1	3	2	3	3	3	3	3	21
B3	1	1	1	2	1	1	2	1	10
B4	1	1	1	1	1	2	2	1	10
B5	1	1	2	3	3	2	2	2	16
B6	1	1	2	3	3	3	3	2	18
B7	1	2	2	3	3	2	2	3	18
G1	4	3	3	3	3	3	3	3	25
G2	1	2	2	3	3	3	3	3	20
SUM	12	15	17	22	21	20	21	19	147

Count: 9 Sum: 147 Mean: 16.333 Median: 18 Mode: 10,18

Application

	Title	Setting	Characters	Problem	Conflict	Accuracy of Facts	Organization	Action	Total
B1	1	1	2	2	2	1	2	2	13
B2	1	3	2	3	3	3	3	3	21
B3	1	1	3	2	2	2	2	1	14
B4	1	2	1	1	1	1	2	1	10
B5	1	3	2	3	3	3	3	2	20
B6	1	3	3	3	2	2	3	3	20
B7	1	2	2	2	3	2	2	2	16
G1	1	2	3	2	2	2	2	3	17
G2	1	3	2	1	1	2	3	3	16
SUM	9	20	20	19	19	18	22	20	147

Count: 9 Sum: 147 Mean: 16.333 Median: 16 Mode: 20,16