

*Autistic Spectrum Disorder and Assistive Technology: Action Research Case Study of Reading Supports*

**James E. Gentry**  
**Tarleton State University**

**Pam Lindsey**  
**Tarleton State University**

*Abstract*

This descriptive action research experience with case study procedures examined the use of best practices paired with assistive technologies as interventions to individualize fiction reading instruction for a high-functioning elementary student, JB (pseudonym), diagnosed with autistic spectrum disorder. JB's instructional, reading goals were to correctly indentify (a) unknown vocabulary words, (b) words with multiple meanings, (c) idiom phrases, and (d) comprehend main story grammar elements within a fictional story line. Also, JB's teachers wanted to see if JB understood (e) characterization within a fictional story. JB's experience reading a fictional text with assistive technological support to accomplish reading skill objectives is described and evaluated by his teachers and researchers.

*Autistic Spectrum Disorder and Assistive Technology: Action Research Case Study of Reading Supports*

Teaching students with autism how to read is lacking in the literature (Bellon, Ogletree, & Harn, 2000; Broun, 2004; Colasent & Griffith, 1998; Lindsey & Gentry, 2008). Vocabulary, phonics, characterization, and story comprehension are the salient topics for reading teachers today (Fountas & Pinnell, 2006; Broun, 2004; Ogle & Beers, 2009). Autistic spectrum disorder (ASD) influences the social and communication exchanges with others (Causton-Theoharis & Malmgren, 2005; Kuoeh & Mirenda, 2003; Smith, Mirenda, & Zaidman-Zait, 2007). ASD characteristics vary in degree from individual to individual, and most experts agree early intervention is needed, targeting social interaction skills and verbal/non-verbal communication skills (National Institute of Neurological Disorders and Stroke, NINDS, 2010). The social and communication challenges shaped by ASD hinder reading instruction (Gentry & Lindsey, 2008). Students with ASD have difficulty making predictions, visualizing the events of the text, and identifying the purpose of a reading (Kluth, 2003; 2005). This leaves reading teachers serving students with ASD with few reading instructional options.

Teachers and parents serving students with ASD increasingly review new methods and tools to provide quality reading instruction (Koppenhaver & Erickson, 1998; Lindsey & Gentry, 2008; Rao & Gagie, 2006). Specifically, students with ASD have a challenge

understanding the social and cultural nuances of language because people with ASD typically have difficulty using background knowledge for comparison while reading a text filled with connotative meanings (Lindsey & Gentry, 2008; McKenzie, Evans, & Handley, 2010). Visual strategies and methods have proven to be exceptional for many students with ASD, but further research into visual supports as well as other strategies is needed. (Fossett, 2005; Lindsey & Gentry, 2008; Tissot & Evans, 2003). Reading for meaning remains the most significant challenge for students with ASD and the educators who instruct them (Randi, Newman, & Grigorenko, 2010; Wahlberg, 2001). Like all students, students with ASD vary greatly; therefore, a single strategy or tool geared to assist students with ASD may be ineffective with some ASD students (Lindsey & Gentry, 2008; McKenzie, Evans, & Handley, 2010). An eclectic approach is best, and assistive technologies offer a myriad of tools for teachers to adapt and use in conjunction with best practices to improve individualized, reading instruction (Gentry, 2006). Few school-based intervention studies have included cultural and setting/stimuli aspects regarding interventions for students with ASD (Machalicek, O'Reilly, Beretvas, Sigafos, Lancioni, Sorrells, Lang, & Rispoli, 2007). This case study includes setting and individual aspects found in a unique class designed to help students with ASD accomplish individualized learning/reading goals.

### **Real Reading and Autism**

Real reading (RR) is best described as individualized, schema driven social process used to gather meaning from abstract symbols (e.g., text or pictures) (Fountas & Pinnell, 2006; Vacca, Vacca, & Mraz, 2011; Vygotsky, 1978). Real reading involves visual, cognitive evaluation, and/or auditory aspects working together in a complex manner (Broun, 2004; Fountas & Pinnell, 2006, Koppenhaver & Erickson, 1998). The reader's schema and learning styles with a text combine to form new meaning (Anderson, 2006; Koppenhaver & Erickson, 1998). This model of reading guided the study's procedures. Students' individualized understandings are created during the process of gathering meaning from reading through the cognitive filter of personal experiences (Bean, Readence, and Baldwin, 2008; Nathanson, 2006; Vacca, Vacca, & Mraz, 2011). Students with ASD, like non-disabled readers, generate meaning in the same individualized fashion (Koppenhaver & Erickson, 1998). Teachers who seek opportunities for their students to experience real reading concern themselves with vocabulary and comprehension instructional methods and resources.

Research focusing on vocabulary instruction revealed systematic, direct instruction of vocabulary as the best teaching practice used to increase learners' understanding of content (Gunning, 2010; Marzano & Pickering, 2005). Recent research by Franken, Lewis, and Malone (2010) found word learning abilities in an ostensive context have been underestimated for students with ASD. In Franken, Lewis, and Malone's (2010) study, students with ASD performed at a significantly higher level than students with moderate learning difficulties. Storybooks may be one of the best mediums to provide an ostensive context for student with ASD to learn words, multi-meaning words, and/or idiom phrases. Learning unknown vocabulary, idiom phrases, and multi-meaning words are important goals for readers since vocabulary deficiency remains the critical cause of

academic failure for disadvantaged students between elementary and high school grades (Gunning, 2010). Students with ASD must build vocabulary and be actively engaged in reading (Gentry & Lindsey, 2008; Wahlberg, 2001). Vocabulary building is an essential aspect of any RR program designed to facilitate reading comprehension.

Comprehension is the individualized, personal understanding of an author's word usage, pictorial representations, story grammar, and/or use of characterization. Reading comprehension has three general levels: "Text Explicit, Text Implicit, and Experienced Based" (Bean, Readence, and Baldwin, 2008, p. 171; Vacca, Vacca, & Mraz, 2011). Text explicit comprehension involves finding answers in the text—called "right there on the page" comprehension. Text implicit begins by inferring what an author is communicating and is often called "between the lines" comprehension. Finally, experienced based comprehension is derived from readers' past experiences with the world and is often referred to as "beyond the lines" comprehension. Therefore, RR involves comprehension of what is read. Gaining meaning from a reading is the goal of any real reading exercise. Garner's (1994) influential research discussed students "lack of interest" in a text affected students' active engagement and the reading of a text. A student's prior knowledge, preferences, vocabulary knowledge, and interest remain the most important consideration when considering story grammar and characterization comprehension goals. Comprehension is individualized understanding of characters, story grammar, and the vocabulary used to express the author's meaning (Bean, Readence, and Baldwin, 2008; Vacca, Vacca, & Mraz, 2011; Nathanson, 2006).

The descriptive study by Colasent and Griffith (1998) discovered individualized understanding of students with ASD was enhanced even more when students draw and write about their stories. Individualization of the story enhanced story grammar and characterization comprehension. Students with ASD benefit from comprehension scaffolding tools like oral reading, story times, multimedia, songs, and other literacy strategies; therefore, students without disabilities and students with ASD both need similar experiences (Akin & MacKinney, 2004; Broun, 2004; ). Students with ASD, like non-disabled peers, are able to participate in RR with support from educators and appropriate resources (Koppenhaver & Erickson, 1998).

### **Story Grammar and Characterization Comprehension for Students with Autism**

Story grammar and characterization remain central to reading instruction today (Fountas & Pinnell, 2006). Past research using social stories with students who have ASD characteristics proved to be a remarkable intervention for targeted behavior challenges (Quilty, 2007; Rogers, 2000; Rogers & Myles, 2001). In Quilty's (2007) study, the students' behavior positively changed by listening to and comprehending individualized social stories. Although this study did not have reading, academic goals, the tacit possibilities from the results of this study indirectly offered hope to teachers who currently work to aid students with ASD in accomplishing individual, targeted reading goals. Students with ASD have the ability to understand the connection between stories read and their individualized perspective of their world (Colasent & Griffith, 1998; Quilty, 2007). Research concerning trade books as a reading comprehension intervention

with children who exhibit ASD is limited; therefore, studies regarding story grammar and characterization are limited as well. For example, one study by Bellon, Ogletree, and Harn in 2000 found repeated reading of storybooks with adult scaffolding proved beneficial for students with high functioning ASD in decreasing echolalia utterances and increasing spontaneous speech. This study provided a glimpse of story grammar and characterization comprehension possibilities for students with ASD.

Story grammar includes many elements. The basic elements of story grammar include an introduction of characters and settings, a conflict or problem, and some resolution or conclusion to the conflict or problem. Characterization instruction includes teaching the traits of characters in the story as well as how said characters develop or transform within a story (Fountas & Pinnell, 2006). Quilty's (2007) study provided inferred evidence pertaining to students who are challenged with ASD as possessing the ability to understand story grammar elements and characterization (character traits and character development) within a story. This is convincing evidence of story grammar and characterization understanding by the change in ASD students' behaviors due to the social stories read with educators. It is imperative to note Quilty's (2007) methodology procedures specified one on one attention between an educator and a student. Like Quilty's (2007) research, repeated storybook reading (RSR) which also embraced adult support for students diagnosed with ASD has proven to be an impactful strategy (Bellon, Ogletree, & Harn, 2000). One on one, direct, and allowances for individualized instruction are the critical instructional interactions needed to develop story grammar and characterization comprehension for students challenged with ASD.

### **Assistive Technology: The New Literacies and Autism**

Some of the most effective resources a teacher can use are assistive technologies. As early as 1995, when computer technologies were first moving into schools worldwide, researchers discovered interactive technological tools improved reading and communication skills of students with ASD and other disabilities (Heimann, Nelson, Tjus, & Gillberg, 1995). Assistive technologies (ATs), such as the Franklin Language Master 6000b (FLM-6000b) (Franklin Electronic Publishers, 1991), digital Power Point stories, and digital video and audio resources are the new literacies today used to develop traditional reading and writing skills (Vacca, Vacca, & Mraz, 2011). New literacies in combination with best teaching practices create powerful instructional, reading rich environments, which provide students engaging visual and auditory cues to experience a story and/or express personal, individualized understanding of readings in novel ways (Gentry, 2006; Gentry & Lindsey, 2008). ATs have provided engaging research-proven practices. These devices have provided novel rereading opportunities, and have granted educators the ability to use novel systematic, direct instructional techniques designed to focus students upon a specific word or phrase meanings in the context of a story (Lindsey & Gentry, 2008).

#### *The Student and the Study's Purpose*

### **Meet JB (Pseudonym)**

JB's diagnosis of ASD was established when he was three years old. His form of ASD was described to researchers as high functioning by the school's diagnostician. JB was a 7 year old boy who loved numbers and the calculator. He enjoyed sensory lab and especially enjoyed swinging on his stomach and talking to people about various topics. Numbers were often used to express feeling. Seven plus eight was used as an expression of disgust or sent as a message to others to stop a behavior deemed as bothersome. Twenty plus three was an expression used to express happiness, welcoming, or gratification. JB used numbers to communicate, but researchers were only able to determine the feelings or meanings of  $7+9$  and  $20+3$ . JB's rationale for using these numbers remained undetermined throughout the study. However, JB's ability to associate abstract numbers to feelings and expression of those feelings provided the premise for this study. Therefore, the study's premise, which guided researchers' behaviors and classroom lessons, was based on teacher input and the researchers' direct experiences with JB. The premise read, *If JB is able to represent his feeling and ideas with abstract representations (i.e.,  $7+9=$  disgust or stop), JB should be able to understand feelings and expressions from abstract representations found in fictional books with adequate, engaging support and scaffolding.*

Past seminal research and philosophies of reading and learning instruction support our research premise for JB (Bodrova and Leong, 1996; Vygotsky, 1978). From the initial interview, JB's teacher called JB a "word caller". She reported, "JB often can call out words and even call out the words in a whole short story. He is a word caller." JB's teacher explained further, "JB often is unable to answer questions relating to the story and decides not to participate." The teacher and researchers predicted the challenge for the study revolved around JB's engagement level with all the reading activities. JB's interests and preference as reported by the teacher and from interactions with JB provided the blueprint for the creation of an individualized reading experience. Individualized reading experiences may be defined as RR (See Real Reading).

### **The Focus for the Instructional Experience**

JB was selected for this study by his teacher, Ms. Brenda (pseudonym). Ms. Brenda wanted JB to correctly identify (a) unknown vocabulary words, (b) words with multiple meanings, (c) idiom phrases, and (d) comprehend main story grammar elements within a fictional story line. Also, Ms. Brenda needed to see if JB understood (e) characterization within a fictional story. These five goals became the focal point of the study and were established by Ms. Brenda and researchers from JB's individualized education plan (IEP). JB, as a learner, was also considered and guided researchers with lesson ideas. Therefore, the purpose of the study was fivefold and was in step with the study's premise. After meeting with JB and his teacher over a two week period, researchers planned an intervention to fit JB's individualized reading, learning needs. Researchers wanted to answer one question. How would JB interact with the reading of a fictional story book using technology supports to meet his individualized learning objectives? This study seeks to describe and evaluate JB's interactive experience with assistive technology and reading instruction.

## *The Method*

The action research approach with case study procedures, like most studies in special education (Pyecha, 1988; Zainal, 2007), was utilized to assist JB's teacher in evaluating JB's progress with meeting reading objectives on his IEP. Because the case study is designed to describe experiences and the outcomes from such experiences, researchers applied a descriptive case study design (Berg, 2004; Yin, 1994; 2009). As Bruce L. Berg (2004), a qualitative research expert, stated, "Case study methods involve systematically gathering enough information about a particular person, social setting, events, or group to permit the researcher to effectively understand how the subject operates or functions" (p. 251).

Researchers in this study wanted to see how JB operated and functioned while experiencing a fictional book with assistive technological tools and the use of best teaching practices support in the intangible areas of (1) learning vocabulary words, (2) words with multiple meanings, (3) understanding of idiom expressions, (4) comprehension following a fictional story grammar format, and (5) the understanding of characterization in a fictional story. The study used established assistive technologies and best teaching practices as the interventions which have proven to be successful when used in combination in recent education research studies (Gentry, 2006; Gentry & Lindsey, 2008). The best practices utilized included high interest and choice consideration for text selection, interactive-tactile concrete learning experiences, multimedia gaming, one-on-one adult support, multimedia audio/visual reading support, digital story books, rereading, and repetition in novel ways (Gentry & Lindsey, 2008; Vacca, Vacca, & Mraz, 2011; Yellin, Jones, and Devries, 2007). These practices were accentuated by several assistive technologies.

JB's baseline data for story grammar comprehension, characterization comprehension, unknown vocabulary words from the story, multi-meaning words, and idiom phrases were established before the intervention experience during the formative assessment process. Descriptive statistics and gain/loss scores provided an objective measure of JB's experience with the ATs used in combination with best teaching practices (See Tables 1 and 2). JB's progress, experiences, behavior, learning interactions with the ATs, and comments were recorded using field notes and photography.

### **Timeframe and Data Sources for the Study**

The study occurred over a fourteen-week period of time. The intervention time in the classroom ranged from one hour to two hours a week. The study was initiated in the spring after the mid-year break and was finalized with data collection ceasing in May. The study did not follow a consecutive week meeting structure due to holidays and a few special events scheduled by the school. Researchers came early in the morning for four of the fourteen weeks to participate in class activities and routines (e.g., snack time) as visiting times. These visiting times allowed researchers to be immersed and accepted by students as routine.

The data sources used by researchers fit the existing classroom environment and schedule. The data sources included (a) direct observation of student interactions with (b) physical artifacts, (c) informal interviews of participants, and (d) formative and (e) summative assessments (Yin, 2009). Also, all observations were recorded in researchers and teacher generated field notes. Photographs were utilized when possible as a recording medium. Also, the last two weeks were used to assess the effectiveness of the intervention, thus, dedicated to artifact performance review, informal interviews' review, field notes review of observations, coding of all text based and pictorial data generated for peer debriefing comparisons (Creswell, 2007). Finally, peer debriefings between researchers and the teacher provided reliability measures and overall oversight to aid in data integrity (Creswell, 1998; 2007). Prolonged time in the field (fourteen visits), including the one to two hour intervention period (eight sessions), aided researchers in developing an in-depth understanding of JB's personality, communication patterns and style, reading strengths, and reading education challenges (Creswell, 2007). The time in the field allowed researchers to adapt and refine lessons for JB as the study progressed and came to a close in May.

## **The Technology and Non-Technological Instruction Tools Used**

JB experienced two technology tools during the intervention: The Franklin Language Master 6000b (FLM-6000b) (See Figure 1) and multimedia modified Power Point 2007 story, gaming, and assessment presentations. The FLM-6000b is an inexpensive device with costs ranging from \$98 to \$130. The FLM-6000b is an electronic device. It is best described as a handheld spell checking, speaking dictionary with a thesaurus. A teacher and a student may use the electronic file box to keep vocabulary learned or in need of review using the LIST function. A student or a teacher can utilize the LIST function to review past entered words for definitions, pronunciations, spelling assistance, or for use in games integrated in the device (e.g., hangman). Microsoft PowerPoint 2007 (MS-PP 2007) provided the multimedia medium to create and play interactive game quizzes (i.e., formative and summative assessments) and to read the chosen story in an interactive multimedia format (e.g., audio sounds and object animations) relating to the study's five goals. Both technologies were chosen because of the low cost and high availability to public schools with limited resources. For example, MS-PP 2007 or some version of Power Point can be found in most public school classrooms today.

Using familiar instructional tools in use in the classroom seemed to be a sensible course of action for the study. Folder matching games were used in this class with visual supports to help students learn vocabulary as well communicate feelings, emotions, and desires. As with the use of PowerPoint 2007, folder games for the study focused JB on various characterization changes made in the story. The folder games were designed for JB to note multi-meaning word differences and idioms differences as well. It is important to note all the ATs and interventions used favored a strong visual support presentation combined with one-on-one adult interactions, repeated readings, individualization of the story read, and games.

## **Preparing for the Intervention Experience**

**JB's Experience with the Technology.** Past research has shown learning new technology can eclipse content learning (Goldman, Cole, and Syer, 1999). With this in mind, JB was introduced to the technologies used in the study before the introduction of the children's storybook and the drive to meet reading goals and research objectives. The FLM-6000b was found to be ineffectual with this student. JB's fascination with numbers and calculators proved to be problematic due to the device's resemblance to a calculator. JB refused to look up or use his electronic vocabulary word list. Instead, he typed numbers and number words for the FLM-6000b to speak aloud. When the researcher asked him to use vocabulary words that did not apply to math problems or numerals, JB became agitated and began repeating his expression for stop— $7+9$  or no. After these experiences, researchers decided to eliminate the FLM-6000b as a means to meet the study's goals for JB.

PowerPoint 2007 did not have these issues. JB had previous experience viewing PowerPoint slides. The researchers played word games with JB using PowerPoint 2007, and he responded to the visual, audio, and object movements related to reading and

graphics with excitement. JB's excitement was observed by his quick movements with his hands in an up and down fashion while laughing. PowerPoint 2007 was deemed as a promising avenue of communication and instruction with JB's learning style and personality in mind.

**JB 's Book Choice.** From conversations and the pre-interviews with the teacher and JB, a book about numbers, mathematics, and social interactions would be preferred. After searching and reviewing several books related to math and social skills, researchers and JB discovered a book authored by Kathryn Otoshi (2008) entitled *One*. This book included several desirable elements. The teacher reviewed the text and stated, "I like the way the book teaches colors and numbers." JB's excitement was expressed by quickly moving his arms and hands while stating, "Hello Mr. Jim." JB named some of numbers and colors he saw as he reviewed the text. Because *One* was favored by researchers, the teacher, and especially JB, *One* was selected as the book to use in the study.

*One* (Otoshi, 2008) was a fictional account of colors who were mistreated by the color Red, the antagonist and villain. The color Blue, the primary protagonist, was a main character in the story and was the object of Red's anger and bullying. The number One, a secondary protagonist, was the hero who by example taught the colors to stand-up to be counted and not let Red's behavior go unchallenged. At the end of the story, all the colors turned into numbers including Red. With Blue's forgiveness and welcoming attitude, Red became part of a larger, positive group dynamic at the end of the story. The moral of the story for a reader involved the idea of standing-up and being counted when encountering bullying; all it took was one (i.e., 1) person to make things better.

**The Text's Analysis.** The fictional story has an introduction, conflict, and resolution. The main characters, Blue and Red, changed during the resolution of the story. Red transformed from a bully with anger issues to fitting-in and respecting others while Blue learned to have self-confidence and to challenge bully behavior with a positive, forgiving nature. Both learned it is better to be friends than enemies. Red and Blue were associated with multi-meaning words: Blue—cool or sad; Red—hot or anger or being mean. Five idiom phrases were discovered: a hot head—quick to anger; blew a fuse—to be angry; took a stand or stand tall—to be proud or brave; everyone counts—all have a purpose or value and are needed; and being blue—being sad. JB's unknown vocabulary needs were determined from JB's reading experience and performance.

**JB's First Experience with the Book *One*.** According to JB's teacher, JB was able to read words he knew aloud. Also, the teacher reported JB read at a normal rate and only paused on words that were unrecognizable to him. A researcher sat with JB and asked JB to read the book, *One*. JB paused his word calling when he encountered the words comforting, regal, and outgoing. The researcher provided the unknown word orally after 10 to 12 seconds passed. JB would repeat the word and continue word calling. The researcher marked the words in field notes. JB's oral reading did not show emotion or expression. He read the text in a monotone manner and lacked intonation.

**JB's Formative/Baseline Assessment.** The formative assessment was conducted over a

two week period during the research meeting time. The researcher created a quiz game using PowerPoint 2007 slides to assess JB’s comprehension of the story, knowledge of the three unknown vocabulary words from the reading experience (i.e., comforting, regal, and outgoing), comprehension of nine multi-meaning words and idiom phrases (e.g., Blue=cool or sad), and the characterization of the story’s main characters (i.e., Red, Blue, and One). The quiz game placed the three unknown words, the four multi-meaning words, and five idiom phrases (e.g., Red and Blue) on a PowerPoint 2007 slides, respectively. Three pictures were displayed below each word or phrase. One picture represented the correct meaning. Before the selection, the researcher asked JB to read the word in the context of the story. Once the respective words were read aloud from the book, JB was asked, “Point the arrow (i.e., mouse’s arrow pointer) to the picture that matches this word in the story (researcher points to word in the book) and click the picture.” If he selected the correct picture, the picture moved, and a clapping sound echoed via the computer’s speakers. JB did not select the correct picture for any of the unknown words. JB matched two of the nine (22%) multi-meaning words and idiom phrases. He matched red to hot but was unable to match red to angry. He matched blue to cool but was unable to match it to its other related word and idiom phrase representations of sad (see Figure 2 & Table 1). JB moved his hands quickly, laughed, and talked when he saw the pictures move with a clapping sound.

Assessing idiom phrase understanding followed the same format used for assessing unknown vocabulary words and multi-meaning words found in the story. While reviewing the idiom phrase, *a hot head*, JB talked about possible choices and pointed to the correct picture on the computer screen using his left hand but changed his mind after a pause to a different picture. JB also touched his head several times. This behavior also occurred when reviewing the idiom phrase, *being blue*. JB was unable to match any of the remaining idiom phrases to related pictures with the mouse pointer. JB possessed no understanding of idiom phrases found in the story with 0/5 (0%) accuracy (See Table 1).

Table 1  
*JB’s Comprehension of Unknown Vocabulary Words, Multi-meaning Words, and Idiom Phrases from Formative/Baseline Assessment to Summative/Post Assessment*

| Understanding of...<br>Unknown Vocabulary, Multi-<br>Meaning Words<br>& Idiom Phrases |            |            | After Experience<br>Gain/Loss<br>(0=same, 1 gain, -1<br>loss) |
|---|------------|------------|---|
|   | Summative: | Formative: |   |
| 1. *comforting  | X          |            | 1   |
| 2. *regal   | X          |            | 1   |
| 3. *outgoing  | X          |            | 1   |
| <b>*Total</b>   | 3/3 (100%) | 0/3 (0%)   | 3/3 (100%)  |
| 1. **Blue→(sad)   | X          |            | 1   |
| 2. **Blue→(cool)  | X          | X          | 0   |

|  |            |           |                  |
|--|------------|-----------|------------------|
| 3. **Red→(angry)                       | X          |           | 1                |
| 4. **Red→(hot)                         | X          | X         | 0                |
| <b>**Total</b>                         | 4/4 (100%) | 2/4 (50%) | <b>2/4 (50%)</b> |
| 1. ***a hot head→ (angry)              | X          |           | 1                |
| 2. ***blew a fuse→(angry)              | X          |           | 1                |
| 3. ***being blue→(sad)                 | X          |           | 1                |
| 4. ***took a stand→(Proud or Brave)    |            |           | 0                |
| 5. ***everyone counts→(all have value) |            |           | 0                |
| <b>***Total</b>                        | 3/5 (60%)  | 0/5 (0%)  | <b>3/5 (60%)</b> |

Note. \*=Unknown Vocabulary, \*\*=Multi-meaning Words, \*\*\*=Idiom Phrases, and X=correct response.

For assessing JB's comprehension of fictional story grammar, researchers followed a related pictorial format used in assessing unknown vocabulary words, multi-meaning words, and idiom phrase understandings. For assessing JB's story grammar comprehension, three directives were issued to JB for identifying story grammar elements of introduction, conflict, and resolution (See Table 2). The introduction of the story involved colors being bullied by the color Red. Therefore, the slide illustrated all the color orb characters in the story (See Figure 3). JB was directed to place a digital ink mark using the digital ink tool of PowerPoint 2007 on all the colors who were treated badly or were pushed around (i.e., Introduction Story Grammar Question). JB used the digital felt tip pen tool and chose the color black as the desired digital ink color for marking and stated, "Twenty plus three." JB marked all the characters with a digital black mark. For the conflict story grammar directive, the same slide was used. JB was asked to mark the color who was told to stop being mean. JB marked the color Yellow. Again, the same slide was used for the story grammar directive concerning the story's resolution. JB was asked to mark characters who became friends at the end of the story. JB digitally marked One, Blue, and Yellow with a mark, respectively (See Figure 3). JB clearly did not comprehend the story read and scored 0/3 (0%) accuracy (See Table 2).

Characterization was closely associated with vocabulary, multi-meaning words, idiom phrase understanding, and story grammar within *One* (Otoshi, 2008). Researchers expected JB to have misunderstandings concerning the story's minor and main characters. The digital ink selection process format used to assess unknown vocabulary words and story grammar comprehension were also used to assess characterization of the major and minor characters portrayed in the story. Researchers were primarily concerned with JB's understanding of the main characters: Blue, Red, and One. JB was able to associate colors to the numbers they transformed into during the resolution of the story by writing the numbers in digital ink over the color orbs (see Figure 4). However, JB was unable to match One, Red, Blue, or other characters to other specific character traits

when asked to digitally mark said characters based on eight researcher prompted questions (e.g., Who was sad in our story?). Of the eight character association questions, two of the eight (25%) were correctly associated. Therefore, eight questions and one directive concerning characterization were utilized with 3/9 (50%) accuracy (see Table 2).

Table 2

*JB's Comprehension of One's Basic Story Grammar and Characterization Elements from Formative/Baseline Assessment to Summative/Post Assessment*

| <b>Characterization Trait Comprehension Questions &amp; Directive</b>                                       | <b>Summative:</b> | <b>Formative:</b> | <b>After Experience Gain/Loss (0=same, 1 gain, -1 loss)</b> |
|---|-------------------|-------------------|---|
| 1. Who was hot in our story? (Red)  | X                 | X                 | 0   |
| 2. Who was very sad in our story? (Blue)  | X                 |                   | 1   |
| 3. Who was cool in our story? (Blue)  | X                 | X                 | 0   |
| 4. Who was mean in our story? (Red)   | X                 |                   | 1   |
| 5. Who was outgoing in our story? (Orange)  | X                 |                   | 1   |
| 6. Who was comforting in our story? (Yellow)  | X                 |                   | 1   |
| 7. Who was angry in our story? (Red)  | X                 |                   | 1   |
| 8. Who told Red to stop picking on others in our story?   | X                 |                   | 1   |
| 9. Associate colors to the numbers they transformed into during the resolution of the story. (See figure 4) | X                 | X                 | 0   |
| <b>Total</b>  | <b>9/9 (100%)</b> | <b>3/9 (50%)</b>  | <b>6/9 (60%)</b>  |
| <b>The Fictional Story Grammar Task Directives</b>  | <b>Summative:</b> | <b>Formative:</b> | <b>After Experience Gain/Loss (0=same, 1 gain, -1 loss)</b> |
| 1. Mark the colors who were treated badly or were pushed around. (Introduction)                             | X                 |                   | 1   |
| 2. Mark the color who was told to stop being mean. (Conflict)   | X                 |                   | 1   |
| 3. Mark who became friends at the end of the story. (Resolution)  | X                 |                   | 1   |
| <b>Total</b>  | <b>3/3 (100%)</b> | <b>0/3 (0%)</b>   | <b>3/3 (100%)</b>   |

Note. X=correct response.

### **JB's Intervention Experience and Findings**

#### **The Rewritten Book with Multi-Media Effects Enhancements Using MS-PP 2007 Slides**

During the formative assessment period, researchers noticed JB's behaviors when he saw the pictures move on the computer screen and heard the clapping sounds with the selection of the correct answer. JB moved his hands quickly, laughed, smiled, and said, "Hello Mr. Jim or twenty plus three." The teacher described this behavior as JB being excited and engaged. Researchers decided to rewrite the story while maintaining the same story line using audio effects, animations, and images to enhance and accentuate the story's introduction, conflict, and resolution as well as the unknown vocabulary words, multi-meaning words, idioms, and the story characters' traits and transformations by the end of the story.

For one session, the introduction of the story was the focus of the day. The introduction of the story followed the book's introduction of the color characters and allowed researchers to directly accentuate with multi-media effects JB's unknown words (i.e., comforting, regal, and outgoing). Also, researchers wanted to point out the colors before they became numbers. Researchers believed this would help JB best understand how the author of *One* (Otoshi, 2008) used characterization. The focus on Blue and Red's character traits before the conflict and resolution of the story allowed JB to experience the polar opposite differences between the two main characters for cognitive comparisons as he continued with the story. Sounds and movement were used as the accentuation tools with each MS-PP 2007 slide depicting story characters. For example, the color purple was a minor character but was also associated with one of JB's unknown words, regal. When JB opened this MS-PP 2007 slide and read, "Purple is regal," he clicked on the arrow (i.e., ) and heard the sound of trumpets playing as a picture moved depicting a man bowing to a king (see Figure 5). With this picture and others, JB laughed, moved his hands quickly up and down, placed his hands close to his face, and said, "Hello Mr. Jim." His response was similar for each slide, and often he would move backward and move forward again in the MS-PP 2007 slide show to hear sounds and see the movements again. The researchers and teacher at times prompted JB to move-on through the story due to this behavior.

Like the introduction session, the conflict of the story was portrayed as the author intended. Red was "picking" on Blue, and Blue was sad about the situation. JB read with excitement (i.e., loud voice and quick hand movements) even when excitement was not needed to explain the story and often moved the slides backward and forward repeatedly to hear sounds and see moments on the computer screen associated with the story as he read. With this session, JB reviewed the multi-meaning words (i.e., Red and Blue) and all the idioms listed in the text analysis (e.g., a hot head → quick to anger) (See Table 1). Also, JB witnessed the colors change from color orbs to color numbers in the text. JB would say the number each color became before reading it from the text in the story for each slide (See Figure 6). Once JB read this from the text, he did not have difficulties matching colors to the numbers each color became. Related to characterization, JB yelled, "Red is hot, and Blue is cool," each time he saw these colors. Researchers prompted JB to move from certain slides because he would linger on a single slide reading the passage over and over again. This was especially evident when he read slides containing Red intimidating other characters in the story. When One encouraged the other colors to not allow Red to pick on Blue, JB excitedly moved his hands quickly near

his face and read the slide over and over again as he laughed aloud. As JB read about the character One, JB would express a mathematical problem with its solution, “One plus 300 is 301.” Although the problem and solution changed per slide, JB’s fascination and genius for mathematics was noticed by researchers throughout the study.

*Figure 6.* In the digital version of the text, JB read about one of the minor characters—Yellow. Yellow (a) was transformed into the number two (b) in the text and digital story versions.

The last reading session involved the resolution to the story illustrating the effects and characterization of the hero, 1, “taking a stand” in opposition to Red’s bullying behavior. As with the other readings, JB responded positively to the sounds (e.g., angry grunts) and movements illustrated on the computer screen. JB moved his hands quickly and laughed when sounds and movements accompanied his readings. When Red grew angrier because of being left out from the other colors’ transformation from orbs to numbers as encouraged by One, JB laughed and moved his hands near his face. JB manifested the same behavior when Red and Blue accepted each other’s differences, and One encouraged Red to join the others by turning into the number 7 (See Figure 7). JB with an excited voice and tone expressed a math problem and solution with the main characters in the story (i.e., One, Red→7, and Blue→6), “ $6+7+1=14$ .” After this reading JB was allowed to move freely through the introduction, conflict, and resolution MS-PP 2007 slides. Researchers noticed JB pausing and reading slides where One was a part of the action of the story. JB said, “One...Hello Mr. Jim,” many times as he perused the slides. Researchers considered this an expression of pleasure.

## **The Games**

Three types of games were created by researchers for JB: folder matching games, magnetic cookie sheet matching, and Popsicle stick puppets. The folder game consisted of a manila folder with Velcro to attach the story’s characters with their matching traits which included the three unknown words from JB’s reading (i.e., comforting, regal, and outgoing). JB’s understanding of the colors transformation from orbs to numbers was used to help him match to more intangible traits like the matching of Red to a hot fire and the term angry (See Figure 8). JB was able to check his answers by using the back of the folder to see a photograph of the correct matching for each character and the three unknown words. This game was chosen because JB was familiar with this game and used this matching game to learn various concepts and vocabulary in various content area subjects.

The magnetic cookie sheet matching game accomplished the same thing as the folder game but was completed with the assistance of a researcher. The characters (e.g., Red), their numbers from transformation(e.g., Red→7), the photographs, the terms representing character traits, the multi-meaning words, and the idiom phrases were printed from a computer and cut-out. Theses cut-outs were laminated and had magnets attached to the back for utilization in the matching game. The researcher would allow JB time to move things around on the cookie sheet with-out prompting. This gave JB time to adjust which

reduced angry outbursts or refusals to participate. First, JB would move the color tags next to their corresponding number tags on the cookie sheet. The researcher would then hand photos and terms respectively representing various character traits or multi-meaning words connected with the characters and numbers in the story (See Figure 9). JB reviewed the story read on MS-PP 2007 slides to check his matching. The researcher assisted JB by moving to appropriate places within the PowerPoint slides. Because JB wanted to start at the beginning and read the entire story before making each match, JB was not allowed to control the computer. JB also wanted to hear the sounds and see the movements on the slides over and over again; this reading behavior was extinguished by turning the computer toward the researcher after a time as a physical cue for JB to perform the matching. Therefore, a routine developed between the researcher and JB. Often JB would call out a number as a cue for the researcher to find a slide for needed information. The researcher selected a slide. JB read the slide. The researcher turned the computer screen from JB. If JB completed a correct match, the researcher would give JB a new photo or term to match on the cookie sheet with one of the characters in the story. If JB was not able to make a correct match, new slides were viewed or the researcher assisted JB in making the correct match. At times, JB wanted to place one of the magnetic strips on the computer screen to perform a matching. JB was reminded that this would damage the computer. JB eventually stopped this behavior after several reminders from researchers and his teacher.

The last game utilized was more open and subjective—Popsicle stick puppets. Each character in the story was glued to a stick. The colors were yarn pom-poms and the numbers were laminated paper. The colors were matched to their corresponding transformation numbers. A color pom-pom was glued to one end of the popsicle stick with its corresponding number glued to the opposite end of the stick (See Figure 10). The researcher asked JB to tell the story. JB used the MS-PP 2007 story's introduction, conflict, and resolution slides. He read the story moving the puppets with the sounds and movements illustrated on the computer screen. JB picked up the puppets in the story as they were mentioned and laid down the puppets no longer being mentioned in the story as the story progressed. When the colors were transformed into numbers, the researcher stopped the story and turned each Popsicle stick around showing the numbers and gave them back to JB to hold upright as the story continued (See Figure 10). When the character One was introduced, JB held the One character popsicle stick puppet in a hand separate from the others. As JB completed the story experience, JB held all the Popsicle stick puppets together moving them as one while the story experience progressed and reached its conclusion. Because JB seemed to enjoy this game, researchers allowed JB to have this experience again. However, JB would not put any of the puppets down during the second reading; he simply read the story and moved all the puppets in his hands with the movements and sounds on the computer. JB did this regardless of which character and/or characters he was reading about on the respective slides.

### **JB Became “One” in the Story**

One of the best practices in reading or writing is a reader experiencing some personal connection to a story or character (Nathanson, 2006). Because communication with JB

was limited, having JB orally retell the story in a narrative format without text or visual supports was viewed by his teacher and researchers as awkward and unsuitable for his learning needs. Researchers chose the hero of the story, One, as the character to have JB relate to in a personal, narrative manner. The story's plot and all characters were the same in this version with one exception; JB's picture/image from the class was attached to the One pictorial representation on all slides (See Figure 11). All references to One changed to JB. JB referred to himself in the third person when communicating with others. His teacher and researchers believed using his name instead of me or I would better simulate a narrative experience of the story reading. This practice had proven successful in diminishing undesired behaviors with students who were challenged with autism (Quilty, 2007). Researchers suspected academic gains for students with autism could be accomplished using similar personalized, story techniques. As before, JB responded to the sounds and movement of each slide with laughter and quick hand movements near his face. His teacher commented on JB as being engaged and having pleasure from the reading experience. When JB saw his image move and appear as the character One, he said, "[JB pointing to his image], Hello MR. Jim...Twenty plus three!" These statements were known to JB's teacher and researchers as expressions of acceptance or pleasure by JB. One behavior issue occurred during this experience. JB wanted to continue reading and seeing his image on the screen (See Figure 11). When JB was asked to move-on or to stop manipulating slides in the story, JB refused and said, "Seven plus nine!"—"No!"—and/or... "Stop!" JB's teacher helped calm JB with a few personal questions. JB read this version in several sessions before the summative assessment. Even though this practice was challenging at times, the teacher and researchers agreed to allow JB to experience his personalized story because of the excitement and interest he expressed.

### **JB's Summative/Post Assessment**

The majority of the summative assessment was fashioned in the same mode as the formative assessment. To avoid testing bias or error between formative and summative assessments, different photographs were used for matching purposes. Respective, varied pictorial representations for JB to match character traits to the story's characters (e.g., Red, Blue, and One), unknown words to meanings (i.e., comforting, regal, and outgoing), idiom phrases to meanings, and the two identified multi-meaning words to meanings (i.e., Red and Blue) became the challenge.

All three unknown vocabulary words were matched to their respective pictorial meaning representations, 3/3 (100%). JB was able to match all picture meaning representations to both multi-meaning words (red and blue), 4/4 (100%) with a 2/4 (50%) gain (See Table 1). He matched red to hot and matched red to its related word angry. JB matched blue to cool and was able to match it to its alternative meaning, sad, as well. JB's idiom phrase understandings were minimal. He was able to relate *a hot head* to pictorial representations of anger (a woman with an angry facial expression) and was able to match *blew a fuse* to anger pictorial representation (a similar aged child with an angry facial expression). JB was able to match the idiom phrase *being blue* to a picture representation of sad (a baby crying). The idiom phrases *took a stand* and *everyone counts* were not indefinable by JB during the selection, and JB refused to make selections

with the mouse pointer. JB said, “Seven plus nine!” to express his dissatisfaction with both assessment items. JB identified pictorial representations for three of the five (60%) idiom phrases (See Table 1).

As with the formative assessment, JB used the digital ink feature found in MS-PP 2007 to digitally write the number on the color orb after the transformation. JB quickly associated the color orbs with the numbers they transformed into at the end of the story. In digital ink he quickly wrote the correct number over each color orb, respectively, with 100% accuracy. The result was the same as the formative assessment. Characterization understanding was evaluated again using the oral questions presented by a researcher during the formative assessment. Eight questions were generated to match character traits to One, Red, Blue, and minor characters (e.g., yellow). JB chose to use red ink this time to make his selections. JB was able to match all character traits to the story’s characters with 100% accuracy and a gain score of 6/8 (75%) (See Table 2).

The same three directives from the formative assessment were used, which included one directed task per story grammar area (introduction, conflict, and resolution). Again, directives were utilized to assess JB’s comprehension of fictional story grammar. JB improved story grammar comprehension from 0% accuracy to 100% accuracy (See Table 2).

### **Peer Debriefing and Data Integrity**

The two researchers and the teacher reviewed the data from formative and summative assessments results, field notes (i.e., teacher and researchers’ notes concerning JB), and interview transcripts. The interpretations of the formative assessment, summative assessment, and the interview transcripts were found to be 100% reliable based on the independent concurring reviews of the researchers and the teacher. The observational field notes contained 3,763 statements and phrases total. Researchers concurred with 95% (3,574.85) accuracy during peer debriefing concerning field note interpretations of JB’s behavior. Descriptions of JB’s behavior were discussed at length. The observations researchers and the teacher could confirm and agree with were reported in the study. Only five percent (189 statements and phrases) of the observations between the three were found without substantiation when compared.

### *Discussion and Conclusions*

Although student choice and interest should always be the first and the most important consideration for meeting RR instructional goals, a student’s individualized perception of an experience or the purpose of a utilized tool can interfere with reading instruction. For example, JB’s fascination and interest with numbers, mathematics, and calculators rendered the FLM-6000b useless and interfered with meeting reading instruction goals. JB only could see a device like this as a calculator and displayed agitated behavior (e.g., Saying, “NO!”) when directed to type-in his unknown vocabulary words into the device. Instead, JB typed numbers into the FLM-6000b to make the device fit his view of a calculator. He typed-in a problem and pressed the SAY function key to hear it through the

speakers. After hearing the problem expressed, JB typed in the solution and listened to the computer read out the problem and the solution. Technology pairing with best RR practices enhanced JB's reading instruction when he understood the purpose and use of such technology. JB performed all the tasks with MS-PP 2007 as instructed. MS-PP 2007 may have fit his paradigm for this tool, thus, no problems.

The individualized, one-on-one, and directed intervention allowed JB to understand the rudimentary story grammar of introduction, conflict, and resolution found in the story *One* (Otoshi, 2008). This study, like previous studies (Bellon, Ogletree, & Harn, 1999; Quilty, 2007), confirmed the positive influence of one-on-one adult interaction with students diagnosed with ASD. Further research is needed to discover if JB will generalize this RR individualized experience with new books he experiences in the future. Regardless of the method or tools used adult support has proven to be a viable component of RR for educators serving students with ASD.

The learning of unknown vocabulary words using the multi-media functions of MS-PP 2007 and best reading practice activities provided JB the novel reading experiences to understand and comprehend his three unknown vocabulary words from the first reading. JB's understanding of multi-meaning words and idiom phrases was not a complete success, respectively, a 2/4 (50%) gain and a 3/5 (60%) gain from the baseline experience to the summative assessment. JB's progress was valued as a positive result by JB's teacher. The teacher reported JB often did not understand cultural idiom phrases in readings and often confused them by attempting literal associations. For example, if the teacher told JB he was cool, JB would feel his head with his hand to see if it was cold. Direct, explicit instruction pointing out the meaning of idiom phrases is needed. The text reading and the picture visuals in the MS-PP 2007 readings offered direct, explicit experiences with the idiom phrases. It is interesting to note the idiom phrases JB was able to remember in the summative assessment were also the ones associated with the two characters who appeared most in the story (i.e., Blue=6 and Red=7). The direct focus on these characters allowed JB to connect these characters traits to their matching idioms. Blue is associated with sadness and red is associated with anger or aggressive behavior in the story many times. Novel representations with multi-media and gaming support aided JB in understanding these idioms' meanings.

Perhaps, the most fascinating result from the study was JB's ability to quickly associate the color orb characters in the story to the numbers they transformed into at the resolution of the story. JB without hesitation from the beginning made these associations seamlessly (e.g., Blue=6) (See Table 2). Researchers were more inclined to look in the text to determine this. Researchers and the teacher, after several peer debriefings, agreed this was possible because of JB's focused curiosity with numbers and everything mathematical. Progress was noted from JB's response to the eight Characterization Trait Comprehension Questions (See Table 2). JB gained 60% growth in comprehension of characterization traits used in the story. JB's excited behavior (i.e., viewed by researchers as positive engagement) when the characters moved on the MS-PP 2007 screen with sound allowed JB focusing time on the key characterization traits. From the text reading, the puppets, and MS-PP 2007 re-readings, JB interaction with the characters in focused

computer aided audio-visual experiences and concrete trait association experiences (i.e., puppets) provided visual and tactile supports. These combined experiences provided JB the needed engaging rereading experiences.

Students with autism may be more apt to engage in repeated re-readings of a text if presented in novel and diverse activities. Assistive technology with multimedia tools allowed researchers various interactive mediums full of color, sounds, and movements to engage and focus JB's attention. JB's engaged demeanor (e.g., hands brought close to JB's face) and positive expressions (e.g., Hello, Mr. Jim) while he experienced the story offered an indication of the positive possibilities accomplished when best practice reading instruction is paired with ATs. Students like JB, who can call-out the words in a story without comprehending the story, need explicit, direct intervention (Marzano & Pickering, 2005). The instructional process and tools used in this study provide an individualized framework for teachers to explore when designing vocabulary and reading comprehension activities for students with autism.

In summary, students with high functioning autism, like JB, may benefit from similar RR instructional practices as well. JB was able to follow and comprehend story grammar and complex characterizations in the story *One* (Otoishi, 2008). Teachers, who work with students diagnosed with autism, have an obligation to start with the interest and dispositions of the student before and while implementing ATs in combination with best RR instructional practices. This study and instructional experience provided an illustration of the process for individualized instruction in the age of technology's infusion into all instructional practices. Regardless of the resources or AT tools used, direct adult involvement as an intervention remains a valuable tool for educators of students with ASD. JB's ability to differentiate idiom phrases, unknown words, multi-meaning words while accurately reflecting and commenting on the fictional story's grammar and complex characterization style offers hope to educators seeking to accomplish academic reading/learning goals with students dealing with ASD.

### ***References***

- Akins, L. & MacKinney, D. (2004). Autism literacy, and libraries. *Children and Libraries: The Journal of the Association for Library Service to Children*, 2(2), 35-43.
- Anderson, R.C., (2006). Role of the reader's schema in comprehension, learning, and memory. In R.B. Ruddell, & N.J. Unrau (Eds.), *Theoretical models and processes of reading* (5<sup>th</sup> ed.). (pp. 594-606). Newark, DE: International Reading Association.
- Bean, T. W., Readence, J.E., & Baldwin, R.S. (2008). *Content area literacy: An integrated approach* (9<sup>th</sup> ed.). Dubuque, IA: Kendall/Hunt Publishing Company.

- Bellon, M., Ogletree, B. T., & Harn, W. E. (2000). Repeated storybook reading as a language intervention for children with autism: A case study on the application of scaffolding. *Focus on Autism and Other Developmental Disabilities*, 15(1), 52-58.
- Broun, L. T. (2004). Teaching students with autistic spectrum disorders to read. *Teaching Exceptional Children*, 36(4), 36-40.
- Berg, B. (2004) *Qualitative research methods for the social sciences* (5th ed.) Boston: Pearson.
- Bodrova, E. & Leong, D.J. (1996). Tools of the mind: The Vygotskian approach to early childhood education. Englewood Cliffs, New Jersey: Prentice-Hall.
- Causton-Theoharis, J. N., & Malmgren, K. W. (2005). Increasing peer interactions for students with severe disabilities via paraprofessional training. *Exceptional Children*, 71, 431-444.
- Colasent, R. & Griffith, P. L. (1998). Autism and literacy: Looking into the classroom with rabbit stories, *Reading Teacher*, 51(5), 414.
- Creswell, J.W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage Publishing.
- Creswell, J.W., Hanson, W.E., Plano-Clark, V., & Morales, A. (2007). Qualitative research designs: Selection and implementation. *The Counseling Psychologist*, 35(2), 236-264. Doi: 10.1177/0011000006287390
- Fossett, B. (2002). *Visual support strategies for literacy development*. Paper presented at the Biennial International Conference on Autism, Kamloops, BC.
- Franken, T., Lewis, C., & Malone, S. (2010). Brief report: are children with autism proficient word learners?. *Journal Of Autism And Developmental Disorders*, 40(2), 255-259.
- Franklin Electronic Publishers (1991). Language Master 6000b.(Computer software and hardware).
- Garner, R. (1994). Metacognition and executive control. In R.B. Ruddell, M.R. Ruddell, & H. Singer (Eds.), *Theoretical models and processes of reading* (4<sup>th</sup> ed.). (pp. 715-732). Newark, DE: International Reading Association.
- Goldman, S., Cole, K., & Syer. C. (1999). *The technology/content dilemma* (Secretary's Conference on Educational Technology). Retrieved from <http://www2.ed.gov/rschstat/eval/tech/techconf99/whitepapers/paper4.html> (accessed 18 January 2011).

- Gentry, J. (2006). The Impact of e-Publishing Assistive Technology in an Inclusive Sixth Grade Social Studies Classroom on Students' Content Learning, Writing, Spelling, and Motivation: A descriptive comparison (Doctoral dissertation, Texas A&M University-Commerce, 2006). *Dissertation Abstracts International*, 66 (11), 3990A.
- Gentry, J. & Lindsey, P. (2008). Creating a culture of literacy for two students with language and learning differences. *Journal of the Effective Schools Project*, 15, 41-53.
- Gunning, T. (2010). *Assessing and correcting: Reading and writing difficulties* (4th ed.). Boston, MA: Pearson.
- Kluth, P. (2003). *You're going to love this kid!: Teaching students with autism in the inclusive classroom*. Baltimore, MD: Brookes Publishing Company.
- Kluth, P. (2005). Tell me about the story: Comprehension strategies for students with autism, Retrieved from <http://www.paulakluth.com/articles/comprehension.html> (accessed 15 January 2011).
- Koppenhaver, D.A. & Erickson, K. A. (1998). Technologies to support reading comprehension in children with disabilities. Center for Literacy and Disability Studies. Retrieved from [http://www.dinf.ne.jp/doc/english/Us\\_Eu/conf/csun\\_98/csun98\\_026.html](http://www.dinf.ne.jp/doc/english/Us_Eu/conf/csun_98/csun98_026.html)
- Kuoch, H., & Mirenda, P. (2003). Social story intervention for young children with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities*, 18, 219–228.
- Lindsey, P. & Gentry, J. (2008). Improving vocabulary skills through assistive technology: Rick's story. *Teaching Exceptional Children Plus*, 5(2), 2-12.
- Machalicek, W., O'Reilly, M.F., Beretvas, N., Sigafoos, J., Lancioni, G., Sorrells, A., Lang, R., & Rispoli, M. (2008). A review of school-based instructional interventions for students with autism spectrum disorders. *Research in Autism Spectrum Disorders*, 2, 395-416.
- Marzano, R. & Pickering, D. (2005). *Building academic vocabulary: Teacher's manual*. Alexandria, VA: ASCD.
- McKenzie, R., Evans, J., & Handley, S. J. (2010). Conditional reasoning in autism: Activation and integration of knowledge and belief. *Developmental Psychology*, 46(2), 391-403.

- National Institute of Neurological Disorders and Stroke, NINDS, (2010). NINDS autism information page. Retrieved from <http://www.ninds.nih.gov/disorders/autism/autism.htm>
- Ogle, D. & Beers, J. W. (2009). *Engaging in the language arts: Exploring the power of language*. Boston: Allyn & Bacon/Pearson.
- Otoshi, K. (2008). *One*. San Rafael, CA: KO Kids Books.
- Pyecha, J., (1988). *A Case Study Of The Application Of Noncategorical Special Education In Two States*. Chapel Hill, NC: Research Triangle Institute.
- Quilty, K. M. (2007). Teaching paraprofessionals how to write and implement social stories for students with autism spectrum disorders. *Remedial and Special Education*, 28(3), 182-189.
- Randi J., Newman T., Grigorenko .E.L. (2010). Teaching children with autism to read for meaning: Challenges and possibilities. *Journal of Autism and Developmental Disorders*. 40(7), pp. 890-902.
- Rao, S. M. & Gage, B. (2006). Learning through seeing and doing: Visual supports for children with autism. *Teaching Exceptional Children*, 38, 26-33.
- Rogers, M. F., & Myles, B. S. (2001). Using social stories and comic strip conversations to interpret social situations for an adolescent with Asperger syndrome. *Intervention in School and Clinic*, 36, 310–313.
- Rogers, S. J. (2000). Interventions that facilitate socialization in children with autism. *Journal of Autism and Developmental Disorders*, 30, 399–409.
- Smith, V., Mirednda, P., & Zaidman-Zait, A. (2007). Predictors of expressive vocabulary growth in children with autism. *Journal of Speech, Language & Hearing Research*, 50(1), 149-160.
- Tissot, C & Evans, R. (2003). Visual teaching strategies for children with autism. *Early Child Development and Care*, 173(4), 425-433.
- Vacca, R.T., Vacca, J.L., & Mraz, M. (2011). *Content area reading: Literacy and learning across the curriculum* (10 ed.). Boston: Pearson.
- Vygotsky, L. S. (1978). *Mind in Society: The development of higher psychological processes*. Cambridge, Massachusetts: Harvard University Press.
- Wahlberg, T. (2001). Language development and text comprehension in individuals with autism. In T. Wahlberg, F. Obiakor, S. Burkhardt, A. F. Rotatori, T. Wahlberg, F.

- Obiakor, ...A. F. Rotatori (Eds.) , *Autistic spectrum disorders: Educational and clinical interventions* (pp. 133-150). Oxford England: Elsevier Science Ltd.  
doi:10.1016/S0270-4013(01)80011-8
- Yellin, D., Blake-Jones, M., & Devries, B. A. (2007). *Integrating the language arts* (4<sup>th</sup> ed.). Scottsdale, AZ: Holcomb Hathaway.
- Yin, R. (1994). *Case study research: Design and methods* (2<sup>nd</sup> ed.). Thousand Oaks, CA: Sage Publishing.
- Yin, R. (2009). *Case study research: Design and methods* (4<sup>th</sup> ed.). Thousand Oaks, CA: Sage Publishing.
- Zainal, Z. (2007). Case study as a research method. *Jurnal Kemanusiaan*, 9. Retrieved from [http://www.fppsm.utm.my/download/doc\\_download/48-case-study-as-a-research-method.html](http://www.fppsm.utm.my/download/doc_download/48-case-study-as-a-research-method.html) (accessed 14 January 2011).

## Figures



Figure 1. Franklin Language Master 6000b



Figure 2.

JB was unable to select the baby crying as a meaning for blue when asked to choose the picture that goes with Blue best. The photographs were used in accordance with Microsoft's fair use clip art/photograph copyright policies.

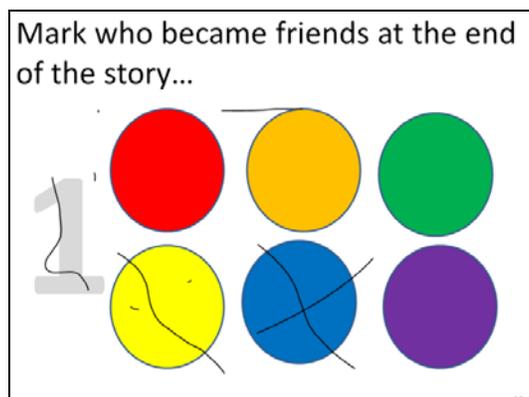


Figure 3. With the black digital ink in PowerPoint 2007, JB incorrectly marked Yellow, Blue, and One as friends at the end of the story.

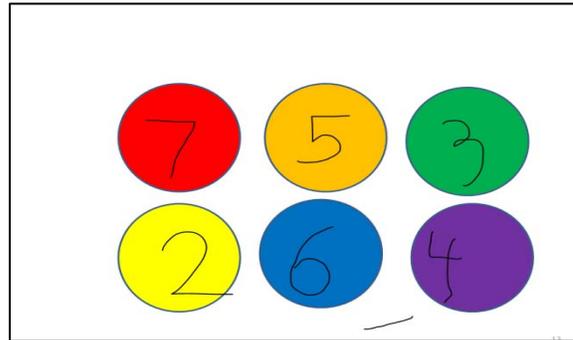
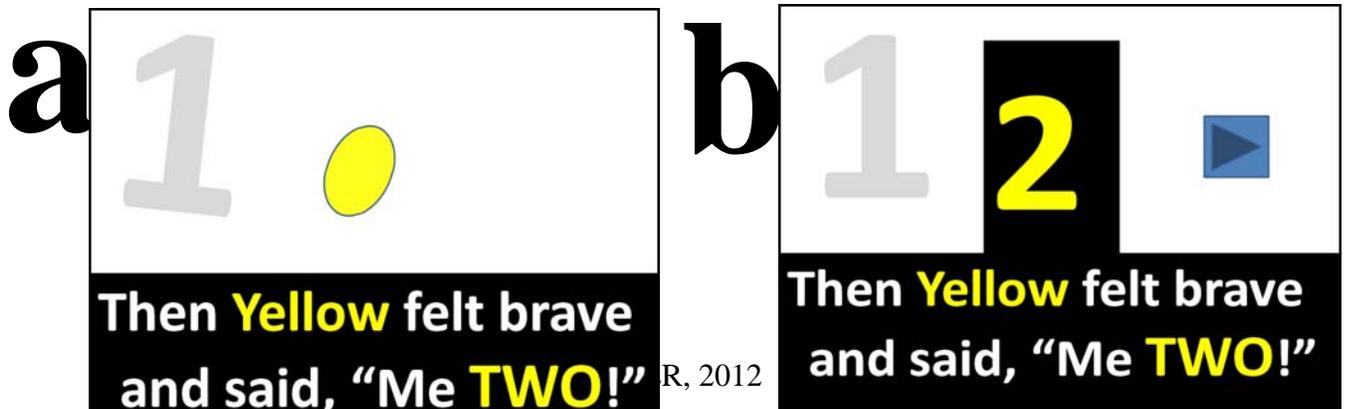


Figure 4. With the black digital ink in PowerPoint 2007, JB correctly inscribed the numbers the color orbs transformed into at the end of the story.



Figure 5. JB read about one of the minor characters—Purple with an associated trait, regal. This reading was enhanced with trumpet sounds and the pictures depicting royalty.

Figure 6. In the digital version of the text, JB read about one of the minor characters—Yellow. Yellow (a) was transformed into the number two (b) in the text and digital story versions.

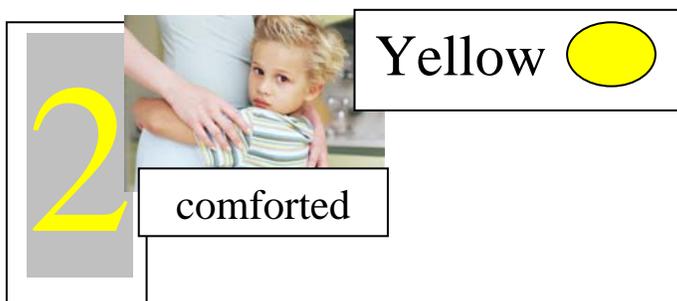




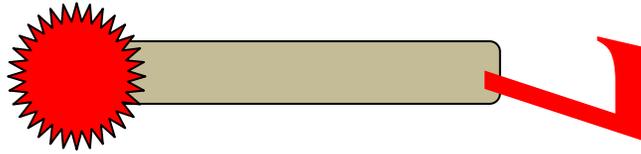
*Figure 7.* JB read how One (1) and Blue (6) encouraged Red to joint and others. Red became number 7. This reading was enhanced with shouts and bouncing sounds as the picture depiction of number 7 moved and bounced across the screen.



*Figure 8.* JB’s folder game where he matched one of the story’s main Characters, Red with number seven, to a pictorial depiction of hot (i.e., fire) and one of the text’s statement concerning Red, “Red is hot.” These laminated tags were attached using Velcro on specific places within the folder. The photographs were used in accordance with Microsoft’s fair use clip art/photograph copyright policies.



*Figure 9.* JB’s cookie sheet game allowed JB to group pictorial representations with other laminated tags defining or describing story vocabulary and character traits found in the story *One*. These laminated tags were grouped together using magnets. The photographs were used in accordance with Microsoft’s fair use clip art/photograph copyright policies.



*Figure 10.* Graphic depictions of two of the popsicle stick puppets used by JB as he read and acted out story elements found in the text *One*.



*Figure 11.* JB's image was attached to the main character, One, from the book *One*. In this digital version, JB is the character One, and his name replaces the name One. JB's face image was blocked for privacy and security concerns.