EFFECTS OF MULTISENSORY SOCIAL STORY ON READING COMPREHENSION AMONG STUDENTS WITH AUTISM SPECTRUM DISORDER

Foo Lip Mun
Loh Sau Cheong, PhD[1]
[1]University of Malaya
Malaysia

Many studies frequently reported reading comprehension difficulty among students with Autism Spectrum Disorder (ASD). Present study has developed multisensory social story (VEKITS) to enhance reading comprehension of students with ASD. A single-subject study with multiple-baseline design was conducted. Three students with ASD and two educators who teach children with special needs participated in this study. Results revealed that students with ASD have high decoding but low receptive vocabulary before the intervention. The level of decoding and receptive vocabulary continues to improve across the phases. The improvement in both variables had resulted in better reading comprehension in all participants. Teachers reported several elements to be markedly enhancing decoding and receptive vocabulary in students with ASD including repetitive read aloud activity, simple and repetitive text. This study is significant in providing essential reading comprehension intervention to students with ASD; likewise, imparting the insights of multisensory strategy to educators for children with special needs.

Keywords: Multisensory social story, reading comprehension, students with ASD

INTRODUCTION

Reading is a complex process involving word recognition and comprehension (Gabig, 2010). It has been the primary element in our lives which is necessary for an individual to obtain a favourable outcome in social, education and vocational aspects (Nelson, Benner, & Gonzalez, 2005). From an educational perspective, reading comprehension is known to be the core pedagogy in teaching literacy skills. A good reading comprehension is vital to achieving academic success (Wright et al., 2011), furthermore, leading an individual to function independently in the future (Chiang & Lin, 2007; Mucchetti, 2013). Without reading comprehension, students are unable to construct the meaning of the written content, fail to make predictions from the text, and most critically,

they are incapable of connecting their prior knowledge to the text (Clarke et al., 2010).

It is vital to develop sound reading comprehension in order to accumulate information while helping students to apply knowledge efficiently. Hence, students are encouraged to engage in reading comprehension activities as early as possible for a productive life (Browder et al., 2009). It is essential to obtain reading comprehension for all students despite severity of their disability (Hua et al., 2012). Therefore, reading comprehension should be identically performed by typically developing students as well as students with ASD (Browder et al., 2009). Nonetheless, the majority of students with ASD are constantly reported with 'reading comprehension disability' (Flores & Ganz, 2007; Speirs et al., 2011; Whalon & Hart, 2011; Whalon, Otaiba & Delano, 2009). More than 65 percent of students with ASD who had measurable reading skills are having difficulty in reading comprehension (Randi, Newman, & Grigorenko, 2010).

Common teaching methods used for enhancing reading comprehension in students with ASD include scaffolding, visually cued instructions, computer-assisted instructions, peer tutoring, cooperative learning groups, anaphoric cuing and procedure facilitation (Chiang & Lin, 2007; Mucchetti, 2013; Whalon et al., 2009). To date, there has been an increase in number of educational setting using multisensory equipment and approaches. Multisensory networks help an individual to combine distinct types of energy in the environment into a coherent and integrated information (Botts, Hershfeldt, & Christensen-Sandfort, 2008). Applying multisensory strategies according to the literacy progress of students with ASD may help to promote better reading comprehension. Students with ASD need appropriate reading comprehension instruction to acquire reading comprehension (Basil & Reyes, 2003). Therefore, the main purpose of this study is to propose an evidence-based multisensory social story for students with ASD. The second purpose of this study is to enhance the reading comprehension of students with ASD using the multisensory social story.

REVIEW OF RELATED LITERATURE

In this study, decoding and receptive vocabulary are two important domains leading to reading comprehension. Absence of either domain will significantly affect the reading comprehension of students with ASD. This is supported by many noted researchers such as Kendeou, Broek, White, and Lynch (2009) who found decoding as independently predicting reading comprehension of children in Second Grade. The importance of decoding in reading comprehension was further supported by Kerins, Trotter, and Schoenbrodt (2010) who stated that having desirable skill in phonemic awareness and letter knowledge in the first two years of school can best predict competent reading comprehension in later age.

It is thus important that students understand the meaning of the text besides decoding the text accurately and fluently. Language comprehension has been widely known as significantly contributing to reading comprehension. This was supported by Guo, Roehrig, and Williams (2011) who found correlations between vocabulary knowledge and reading comprehension. Besides, Bianco and colleagues (2012) conducted a three-year longitudinal study to examine the relationships between oral language development, early training program on word identification and reading comprehension. Their study indicated the significant contribution of oral comprehension on reading comprehension of pre-kindergarten and first grade children. This is paralleled with the findings done by Ricketts et al. (2013) where oral language comprehension has been shown to be a unique predictor of reading comprehension.

Reading Comprehension among Student with Autism Spectrum Disorder

Reading comprehension is a process where readers involve in written text and then construct the meaning of the text. It often involves complex cognitive demands due to the increasing length and difficulty level of the comprehension text (Randi et al., 2010). Students with ASD often develop sound decoding. However, comprehension is a common key impairment in this population (Wei et al., 2015; Whalon et al., 2009).

Several studies had examined the reading comprehension level of students with ASD. For instance, Nation, Clarke, Wright, and Williams (2006) investigated the reading skills in students with ASD. The mean standard scores of word reading, text reading and non-word reading of participants fell within the normal range. In contrast, 65 percent of the participants were one standard deviation below the normal population and 38 percent were more than two standard deviations below the normal population for reading comprehension. This is similar to the result of Huemer and Mann (2010) where participants with ASD scored generally at or above the population in decoding, while below the population in comprehension. These results indicated poor reading comprehension in the majority of participants.

Whalon and Hart (2011) conducted a qualitative research to study the engagement and participation in reading and language arts instructions of three students with ASD who received reading instruction in the general education classroom setting. The results were consistent with previous findings where participants with ASD performed well in decoding but struggled with language and reading comprehension. They indicated a limited emphasis on comprehension strategy instruction during literacy activities which had minimized the comprehension development of students with ASD and this had led to reading comprehension difficulties.

Also, weak reading comprehension among students with ASD was supported by Arciuli, Stevens, Trembath, and Simpson (2013) through direct assessment, as well as parent report of adaptive behaviours of the child. In

word-level accuracy, results demonstrated 29 percent of participants fall at least one standard deviation below the normal population, 48 percent within one standard deviation and 23 percent scored at least one standard deviation above normal population. In passage-level accuracy, 39 percent fall at least one standard deviation below the normal population, 50 percent within one standard deviation and 11 percent scored at least one standard deviation above the normal population. In passage-level comprehension, 53 percent of participants scored at least one standard deviation below the normal population, 35 percent were within one standard deviation and 12 percent scored at least one standard deviation above normal population. This study indicated different reading ability among students with ASD.

Multisensory Teaching for Students with Autism Spectrum Disorder

Multisensory teaching that was originally developed from the Orton-Gillingham Approach has been widely used to teach reading and spelling among students with literacy problems (Joshi, Dahlgren, & Boulware-Gooden, 2002). In Orton's 1925 theory of reading development, he proposed that visual representations occur in the posterior right hemisphere and this would interfere with proper word identification, and children would have to dissociate such representations to learn to read (Turkeltaub et al., 2003). Orton hypothesized that individuals with reading difficulties often failed to establish appropriate cerebral organization which is used to support the association of visual words with spoken form. A concept of multisensory instruction was introduced to integrate both left and right brain functions in reading instruction (Reading Horizon, 2014). Through multisensory instruction, the simultaneous use of visual, auditory, and kinaesthetic-tactile strategies are important to enhance memory and learning (Campbell, Helf, & Cooke, 2008).

Parents of children with learning disability supported multisensory teaching as significantly improving the reading skills of their children (Bhat, Rapport, & Griffin, 2000). Positive effects on the use of multisensory teaching were demonstrated in existing studies (Campbell et al., 2008). Empirical evidence of multisensory teaching efficacy on reading skills of children was provided by Joshi, Dahlgren, and Boulware-Gooden (2002). The Houghton-Mifflin Basal Reading Program was used to teach the control group and Language Basics: Elementary (an Orton-Gillingham-based Alphabetic Phonics Method) was used to teach the treatment group. The findings showed that children in the treatment group who were taught using multisensory teaching approach made statistically significant gains in phonological awareness, decoding, and reading comprehension; children in the control group improved only in reading comprehension.

Likewise, a multiple baseline study on effects of adding multisensory elements to a reading program was conducted by Campbell et al. (2008). However, this study only focused on the decoding skills of treatment resistant

children. Results of the study support the adding of multisensory components (included finger tapping, letter formation on carpet squares, and the use of magnetic letters) in reading intervention which can improve fluency of decoding vowel-consonant (VC) and consonant-vowel-consonant (CVC) nonsense words. Also, improvements were found in fluency of sound recognition within VC and CVC words, oral reading fluency of First Grade passages as well as grade-level passages.

In recent years, multisensory teaching was conducted in classroom-based setting using the multimodal texts with Information and Communication Technologies (ICTs) to support literacy learning and engagement in young children with ASD. Oakley et al. (2013) found improvement in participants' alphabetic and phonics knowledge as well as engagement when their visual skills were built, linking concrete materials and connecting interests and life experiences using a multisensory approach. Using multisensory elements will help students to interact better with their environment, respond faster besides providing better perceptual illusions of past experiences, meanwhile assisting students with ASD to form a more organized schema (Stevenson, Zemtsov, & Wallace, 2012).

METHODOLOGY

Research Design

The single-subject research with multiple baseline design across participants was applied to obtain a three-step sequential phase consisting of baseline, intervention and maintenance, for three students with ASD. This research design is primarily applied in special education research as many of the usual designs are not applicable for students with special needs (Fraenkel, Wallen, & Hyun, 2012). Moreover, two supplementary qualitative measures (participant observation and semi-structured interview) were used in this study. The qualitative data provides an in-depth explanation and supports the quantitative method used in this study.

Setting

The researcher purposefully selected a setting based on the following criteria: (a) enrolment of students with ASD from Fourth to Sixth Grade, and (b) consent to participation. A private school for individuals with special needs located in Kuala Lumpur, Malaysia was selected. The school has a total of ten classes, from Kindergarten to Vocational. Each class consists of students with different learning needs; however most were with ASD. Students are categorized into different classes according to their individual ability; apart from that, age is also a consideration. The school learning program focuses on literacy, numeracy

concepts, communication and language skills, social skills, movement and sensory issues of students with special needs.

Participants

The criteria for selecting students in this study are: (a) formally diagnosed with ASD, and (b) presence of prerequisite skills in reading including phonemic awareness, phonics, fluency and vocabulary. With the agreement of parents and Head Teachers, background data of the students were collected from their Individualized Education Program (IEP) obtained from the school, also, information given by their Head Teacher; three students with ASD were involved. Informed consent was obtained from the parents, teachers and school management prior to the study. Codes were used to refer to all participants to maintain confidentiality. Hereafter, the three students are referred to as Student A, Student B, and Student C.

Teachers in this study were required to meet the following criteria: (a) minimum 3 years teaching experience with student with ASD, (b) taught Fourth to Sixth graders with ASD in their current caseloads, and (c) minimum 2 years teaching experience in the Malaysian context. Two teachers from the present school were selected in this study. Prior to the study, the researcher met with the teachers to explain the purpose of the study.

Materials

In this study, material used throughout the intervention phase was a multisensory social story book (VEKITS). VEKITS was developed specifically for this study to teach reading comprehension. In this study, it concerned particularly on reading comprehension of morning routines. A multisensory book with the title '*Good Morning*' was used to serve as a medium to implement VEKITS. This book had six parts, each representing one setting of the house. The settings include two bedrooms, one bathroom, one changing room, one dining room and one shoe closet. It consisted of three-dimensional popping up doll-size furniture, decorations, and props. There were nineteen different types of textures and surfaces used in this book. A male rag doll and a female rag doll were prepared to represent the character in the written text. Students had to play with the rag doll as if they were performing the daily routines as stated in the text. In every page, students had to play with the rag doll and complete actions mentioned in the text.

In the maintenance phase, a social story book with the title *'Good Morning'* was used. The contents of the text were written by the researcher. Each page contains five sentences describing daily morning routines. The sentences heavily emphasized on repetitive sight words to improve the reading comprehension of students with ASD. The texts were written based on six modules including waking up, making the bed, toilet relief, freshening and

dressing up, morning greeting and breakfast manners, and lastly, leaving for school. The process of using '*Good Morning*' book incorporates the integration of six elements in VEKITS including visual supports, emotions stability, kinaesthetic experience, intellectual development, tactile experience, and speech development.

Social Story Book

A social story book was developed for use during maintenance phase. The book consisted of six pages of written text, with the same content as in the *'Good Morning'* book. A color printed illustration was presented at the right page, next to the written text.

Assessment

Literacy Assessment

Baseline level of reading comprehension of each participating student was assessed by the Head Teacher using the Reading A-Z online reader series. It is an online curriculum resource (https://www.readinga-z.com/books/leveled-books/) used by the teachers in the participating school to assess students' literacy level.

VEKITS Running Record

VEKITS Running Record was developed to record the decoding performance and action performance of students throughout the intervention phase. Decoding performance of students was recorded according to untimed reading accuracy rate. Without time limitation, each error and self-correction in decoding was recorded. Self-correction words were calculated as correct words. The percentage scores of 81 to 100 indicated excellent level of decoding, scores of 61 to 80 indicated very good level; 41 to 60 indicated good level; 21 to 40 indicated fair level, and 1 to 20 indicated weak level of decoding. Effort mark (one mark) was given to the student who has been putting effort to complete the assessment but scored zero in the total decoding performance.

Next, to measure action performance, an action performance rubric was developed for consistent rating. The number of rating was recorded. Student who scored between the rates of 127 to 150 indicated excellent action performance; between 103 to 126 indicated very good action performance; between 79 to 102 indicated good action performance; between 55 to 78 indicated fair action performance. Lastly, rating within 30 to 54 indicated weak action performance.

VEKITS Reading Comprehension Assessments

VEKITS Reading Comprehension Assessments were developed to measure reading comprehension of students during the maintenance phase. Three sets

of assessment were developed to measure reading comprehension in three consecutive days, with each set being assigned on a different day. Question-Answer Relationship (QAR) strategy was implemented in the assessment. Questions were established from the text in the '*Good Morning*' book. There were a total of seven questions in the first assessment, nine questions in the second, and eleven questions in the third assessment. The questions included both literal and inferential questions. An example of a literal question in the assessment is: "Every morning, I wake up at ___ o'clock" (Answer: 7 o'clock). An example of an inferential question in the assessment is: "Where do you have your breakfast?" (Answer: dining room). Three answer choices were provided in each question. Number of correct answers was recorded into text-based column and inferential column accordingly. Effort mark (one mark) was given to the student who has been putting effort to complete the questions but scored zero in the total assessment. Answer list was provided in each assessment set.

Interview Protocol

An interview protocol was designed for this study. The interview questions were validated by a panel of three experts with many years of experience in special education.

Instrument Validity and Reliability

To assess the instrument validity and reliability, three qualified panels with related background in special education were invited to evaluate the instruments. Instruments validation from the panels are important to ensure that instruments are suitable for students with ASD, also to ensure they cover content that measure the objectives of the study. Besides, face validity of the instruments was validated by the panels. Cross-checking was done by the panels to examine, judge, and provide guidance on the items and format in the instruments.

Data Collection Techniques

Three methods were involved in data collection to gather both quantitative and qualitative data. Firstly, quantitative data on student's reading comprehension performance were collected during the baseline, intervention, and maintenance phases, in a classroom setting. Secondly, participant observation using field notes was used to gather qualitative data during the VEKITS implementation in the intervention phase. The field notes include descriptive and extensive data. Observation protocol was used as guidance for note taking. Extensive recording of field notes took place immediately after the intervention.

Daily video recording was conducted throughout the baseline, intervention and maintenance phase. The researcher watched and coded all the recorded

video clips using a coding form. Reading comprehension of participating students was coded when they were able to decode the words and perform receptive vocabulary skill accurately for each sentence (during intervention phase) or question (during baseline and maintenance phase).

Considering this study focuses on experiences of using a newly developed multisensory social story on students with ASD, it is evident to apply the interview method as an essential tool to explain and triangulate the results from nonparticipant observations. Semi-structured interview was conducted at the end of the maintenance phase to gather feedback from teachers implementing VEKITS and to collect their opinions regarding the overall reading comprehension of students following VEKITS implementation in order to reduce observational biases. Hence, the semi-structured interview was used to assure the validity of field notes. To increase the accuracy of reporting, semi-structured interview with teachers was audio-recorded and subsequently transcribed into verbatim. Teachers were requested to verify the transcript to be attached with researcher's field notes.

The researcher took notes throughout the interview sessions. The interviews lasted approximately 30 minutes for each teacher. Teachers were requested to perform member checking with their interview transcript in order to verify the interview data.

Treatment Fidelity

Treatment fidelity was conducted to evaluate if the VEKITS training and intervention procedures were implemented as planned. A total of three fidelity checklists were developed to measure the treatment fidelity of the study. Among the checklists, two were distributed to the teachers to guide them with the appropriate procedures across the intervention phases. Different fidelity checklist was distributed according to the shift of intervention condition. In the intervention and maintenance phases, the researcher met up with the teachers during their convenient time of the day to review and discuss the steps outlined in the checklist when necessary. Fidelity checklist was completed each day during the intervention and maintenance phases of the study. In the meantime, the researcher also conducted fidelity checks during the intervention and maintenance phase for all participating students at random. In this study, 100% treatment fidelity was observed during maintenance phase and VEKITS training. In intervention phase, treatment fidelity did not reach 100%; however, it was still high, ranging from 95% to 99% in all three participating students.

Data Analysis

Data collected from nonparticipant observation were analyzed using visual inspection of graphed data. Multiple baseline graphs were used to present the results from baseline to maintenance phase. From the graph, percentage of

intervals of dependent variable (reading comprehension) was displayed on the ordinate (*y*-axis) and the number of sessions across the study was displayed on the abscissa (*x*-axis). Due to the use of multiple-baseline across participant design in this study, line graphs were plotted for each participating student, from baseline to maintenance phase. The graphs demonstrated the reading comprehension between the participating students across the phases. Additionally, pattern of data between students across the three intervention conditions were compared. Changes in the level of performance of each student between baseline and intervention phase were calculated. Besides that, changes between interventions to maintenance phase, as well as the magnitude of performance during maintenance phase were measured.

Thematic analysis method was employed to analyze qualitative data. Descriptive analysis was mainly used to analyze all data from participant observation and teachers' interview. Before analysis, data from field notes and interviews were presented in extensive transcripts. Semantic codes were used to summarize the explicit content in the transcripts. Data extracted from participant observation and teachers' interview were collated into groups of codes which were then further analyzed to form emerging themes.

RESULTS

Decoding Skills of Students with Autism Spectrum Disorder

Decoding level of all participating students throughout the study was examined, as summarized in Table 1. Prior to intervention, all participating students displayed decoding levels above 80% of mean percentage. Among three participants, Student C showed relatively lower level of decoding (mean decoding = 84.4%). Student A and Student B had higher decoding skills with mean percentage of 94.4% and 89.6%, respectively.

Table 1
Range and Mean Percentage for Decoding in Students with Autism Spectrum Disorder

Phases	Baseline		Intervention		Maintenance	
	Range	Mean	Range	Mean	Range	Mean
Student A	93.2-95.5	94.4	98.3-100.0	99.8	100.0-100.0	100.0
Student B	89.2-90.5	89.6	98.9-100.0	99.5	98.9-100.0	99.6
Student C	82.4-87.8	84.4	84.0-98.9	94.2	98.9-100.0	99.3

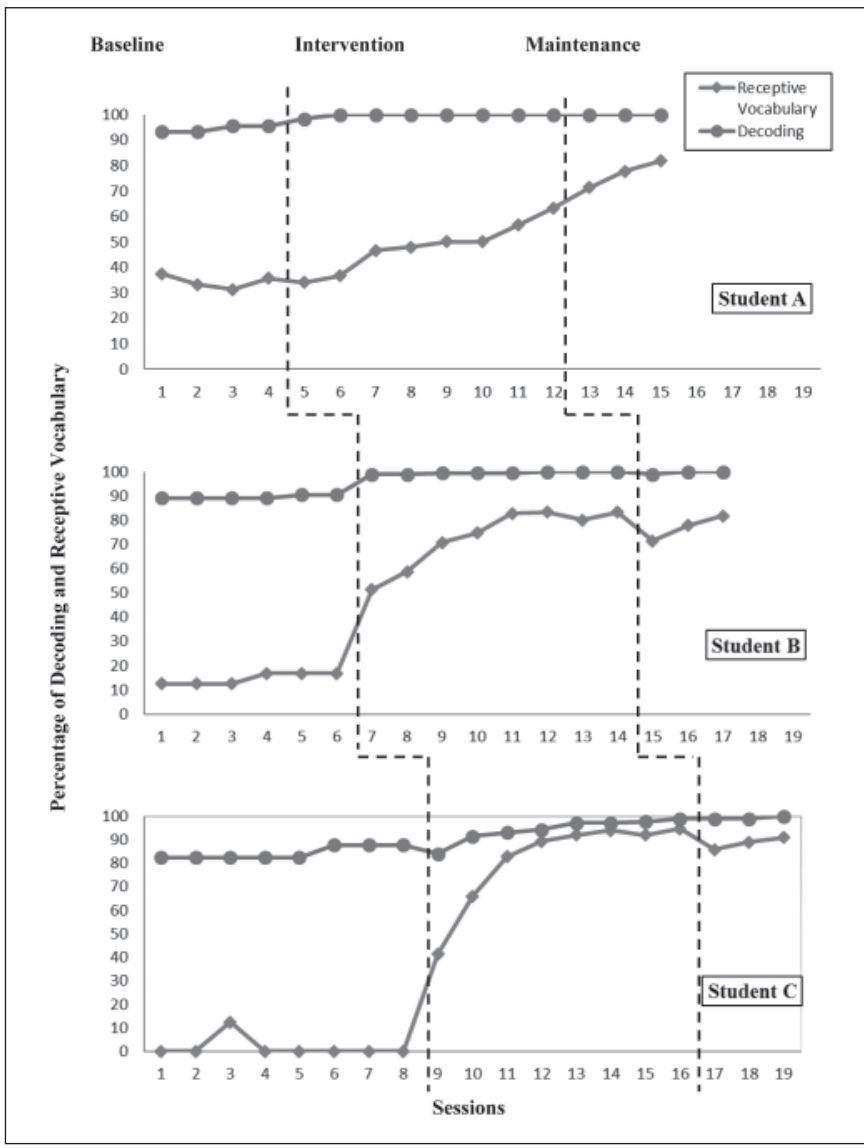


Figure 1. Percentage of decoding and receptive vocabulary across phases.

The overall percentage for decoding in the initial stage of the study ranged from 82.4% to 95.5%. Throughout the intervention, all participating students showed improvement in decoding. Most significant improvement was found in Student C, with an increase of 14.9% at the end of intervention. Student A and Student B showed increase of 1.7% and 1.1% in decoding, respectively.

During intervention, all participating students achieved high level of decoding with a mean percentage of 99.8% for Student A, 99.5% for Student B, and 94.2% for Student C. Decoding of the students remained high in the maintenance phase where all of them scored greater than 99% of mean percentage in decoding. Figure 1 shows the percentage of decoding and receptive vocabulary across three phases in three participating students with ASD.

Receptive Vocabulary Skills of Students with Autism Spectrum Disorder

The baseline results in the VEKITS Running Record were reported to examine the level of receptive vocabulary of the three participating students with ASD. Table 2 summarizes the range and mean percentage for receptive vocabulary in three participating students with ASD. Figure 1 presents the percentage of receptive vocabulary across three intervention phases in three participating students with ASD.

Table 2
Range and Mean Percentage for Receptive Vocabulary in Students with Autism Spectrum Disorder

Receptive Vocabulary	Baseline		Intervention		Maintenance	
	Range	Mean	Range	Mean	Range	Mean
Student A	31.3-37.5	34.5	34.0-63.3	48.2	71.4-81.8	77.0
Student B	12.5-16.7	14.6	51.3-83.3	73.1	71.4-81.8	77.0
Student C	0-12.5	1.6	41.3-94.7	81.5	85.7-90.9	88.5

In contrast to the results in decoding, receptive vocabulary scores in all three participants were low in the baseline phase. The mean percentage of Student A was 34.5% and Student B was 14.6%. Student C scored lowest among all participants with the mean percentage of 1.6%. Subsequently, study showed significant improvement in the level of receptive vocabulary during intervention phase. The overall percentage range for receptive vocabulary in the initial stage of intervention was 34.0% to 51.3% (refer Table 2).

Throughout the intervention phase, Student C showed the most significant improvement in receptive vocabulary. An increase of 53.4% in receptive vocabulary with the mean percentage of 81.5% was found in Student C. Also, steady improvement was found in Student B with an increase of 32% throughout the intervention and a mean percentage of 73.1%. Student A who has the highest level of decoding has shown the least improvement in receptive vocabulary with an increase of 29.3% and a mean percentage of 48.2%. The overall percentage range for receptive vocabulary at the end of intervention was 63.3% to 94.7%. For Student B and Student C, a minor slip back was found in the seventh session followed by an improvement in the final intervention.

Student A continued to show improvement in receptive vocabulary when the study entered the maintenance phase. For Student B and Student C, level of receptive vocabulary was in accelerating trend although there was slight decline shown during the transition from intervention to maintenance phase. All participants achieved greater than 80% in receptive vocabulary at the end of the study.

Reading Comprehension of Students with Autism Spectrum Disorder

Reading comprehension of participating students was evaluated for changes in level, mean and trend across phases. Range and mean data of reading comprehension was displayed in Table 3. Figure 2 presents the percentage of intervals with reading comprehension in three participating students with ASD. Besides that, the researcher also carried out participant observation during the intervention phase.

Table 3
Range and Mean for Percentage of Intervals with Reading Comprehension of Students with Autism Spectrum Disorder Across Phases

Dependent Variable	Baseline		Intervention		Maintenance	
	Range	Mean	Range	Mean	Range	Mean
Student A	33.3-37.5	35.4	20.0-73.3	53.8	71.4-81.8	77
Student B	12.5-16.7	14.6	60.0-90.0	77.9	71.4-81.8	77
Student C	0-12.5	1.6	23.3-93.3	69.2	85.7-90.9	88.5

Prior to the intervention, Student A scored highest in reading comprehension (mean = 35.4%) among all participating students, following by Student B (mean = 14.6%) and Student C (mean = 1.6%). Baseline performance was relatively stable in all participating students. There was a marked increase in reading comprehension of Student B and Student C when intervention was first introduced. Reading comprehension of Student B and C, shifting from baseline to intervention phase, went up by 43.3% in Student B and 23.3% in Student C. Unlike Student B and Student C, a slump was observed in Student A when first intervention session was conducted.

Within the intervention phase, reading comprehension of all participating students followed an accelerating trend. Reading comprehension for Student A and Student B was gradually increasing. For Student C, rapid improvement was observed particularly during the first five intervention sessions. Mean percentage of reading comprehension in all participating students had significantly increased from baseline to intervention phase. There was a slight decline in all participating students when the study was transitioning from intervention to maintenance phase. This was more obvious in Student B.

During maintenance phase, mean percentage for reading comprehension continued to rise in Student A and Student C. The reading comprehension level of Student A at maintenance phase was distinctly higher than that in the intervention phase with an increase of 23.2%. For Student B, mean percentage in maintenance phase was somewhat decreased (-0.9%) compared to the intervention phase. By comparison, Student C performed generally better than other participants in maintenance phase, despite her lowest reading comprehension observed in baseline phase. All in all, three participating students showed improvement in reading comprehension across the maintenance phase.

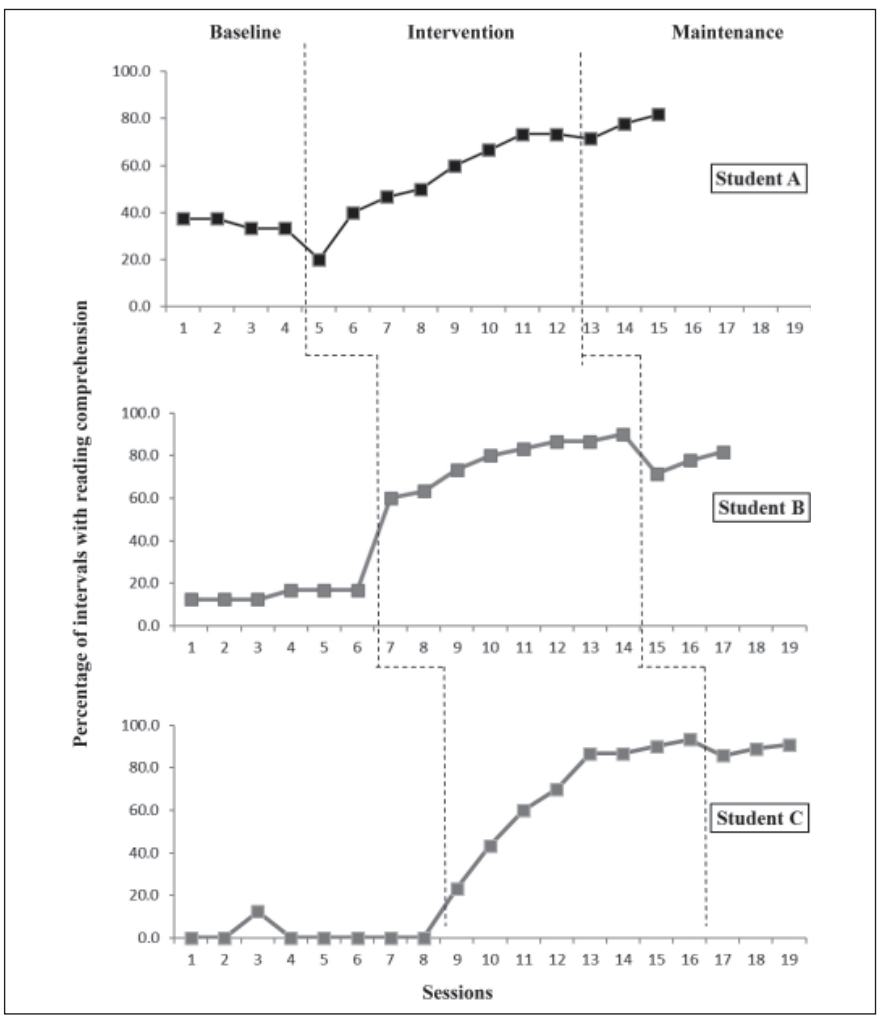
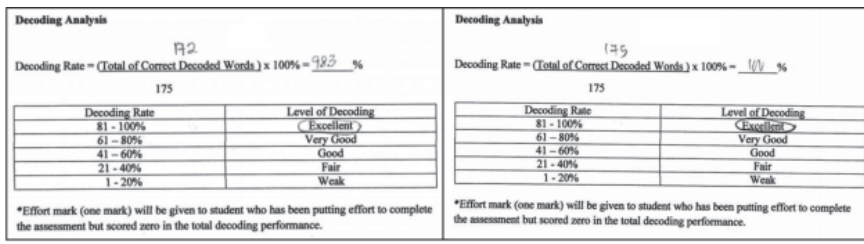


Figure 2. Percentage of intervals with reading comprehension across phases.

Enhanced Decoding

Data collected from participant observations and teachers' interview had reported a clear improvement in students' decoding across the intervention phase (refer to Figure 3).



Decoding Analysis

Decoding Rate = (Total of Correct Decoded Words) x 100% = 98.3 %

172 / 175

Decoding Rate	Level of Decoding
81 - 100%	(Excellent)
61 – 80%	Very Good
41 – 60%	Good
21 - 40%	Fair
1 - 20%	Weak

*Effort mark (one mark) will be given to student who has been putting effort to complete the assessment but scored zero in the total decoding performance.

Decoding Analysis

Decoding Rate = (Total of Correct Decoded Words) x 100% = 100 %

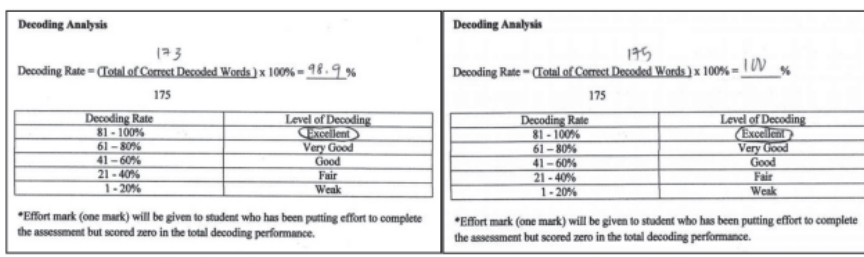
175 / 175

Decoding Rate	Level of Decoding
81 - 100%	(Excellent)
61 – 80%	Very Good
41 – 60%	Good
21 - 40%	Fair
1 - 20%	Weak

*Effort mark (one mark) will be given to student who has been putting effort to complete the assessment but scored zero in the total decoding performance.

First Session *Last Session*

(a) Differences in decoding of Student A



Decoding Analysis

Decoding Rate = (Total of Correct Decoded Words) x 100% = 98.9 %

173 / 175

Decoding Rate	Level of Decoding
81 - 100%	(Excellent)
61 – 80%	Very Good
41 – 60%	Good
21 - 40%	Fair
1 - 20%	Weak

*Effort mark (one mark) will be given to student who has been putting effort to complete the assessment but scored zero in the total decoding performance.

Decoding Analysis

Decoding Rate = (Total of Correct Decoded Words) x 100% = 100 %

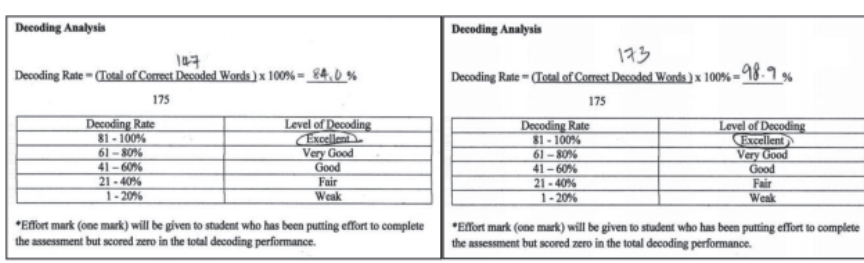
175 / 175

Decoding Rate	Level of Decoding
81 - 100%	(Excellent)
61 – 80%	Very Good
41 – 60%	Good
21 - 40%	Fair
1 - 20%	Weak

*Effort mark (one mark) will be given to student who has been putting effort to complete the assessment but scored zero in the total decoding performance.

First Session *Last Session*

(b) Differences in decoding of Student B



Decoding Analysis

Decoding Rate = (Total of Correct Decoded Words) x 100% = 84.6 %

147 / 175

Decoding Rate	Level of Decoding
81 - 100%	(Excellent)
61 – 80%	Very Good
41 – 60%	Good
21 - 40%	Fair
1 - 20%	Weak

*Effort mark (one mark) will be given to student who has been putting effort to complete the assessment but scored zero in the total decoding performance.

Decoding Analysis

Decoding Rate = (Total of Correct Decoded Words) x 100% = 98.9 %

173 / 175

Decoding Rate	Level of Decoding
81 - 100%	(Excellent)
61 – 80%	Very Good
41 – 60%	Good
21 - 40%	Fair
1 - 20%	Weak

*Effort mark (one mark) will be given to student who has been putting effort to complete the assessment but scored zero in the total decoding performance.

First Session *Last Session*

(c) Differences in decoding of Student C

Figure 3. Data comparison on first and last day of intervention on decoding.

Student A and Student B did exceptionally well in decoding. Student A achieved 100% decoding since the second intervention session while Student B achieved 100% decoding after the fifth session. Student C who needed most prompting to decode words in the beginning of intervention was able to decode most words, sometimes with self-correction, at the end of intervention. Their reading accuracy and fluency were observed to improve across the phase. The repetition

of read aloud across eight days of intervention has significantly improved the level of decoding in all participating students with ASD. Besides that, teachers in this study had emphasized on the repetitive read aloud as the main element to reading fluency. Improvement in decoding of students was further supported by the VEKITS running records through comparison of the first and last day of intervention.

Increase Understanding of Text

Throughout the study, all participating students were showing improvement in understanding of text. Among all participants, Student A had shown the least improvement in understanding the text using VEKITS. He did not understand the text and he performed different action from the written text. His understanding improved gradually across the intervention phase. Teacher had provided scaffolding when necessary (refer to Figure 4).

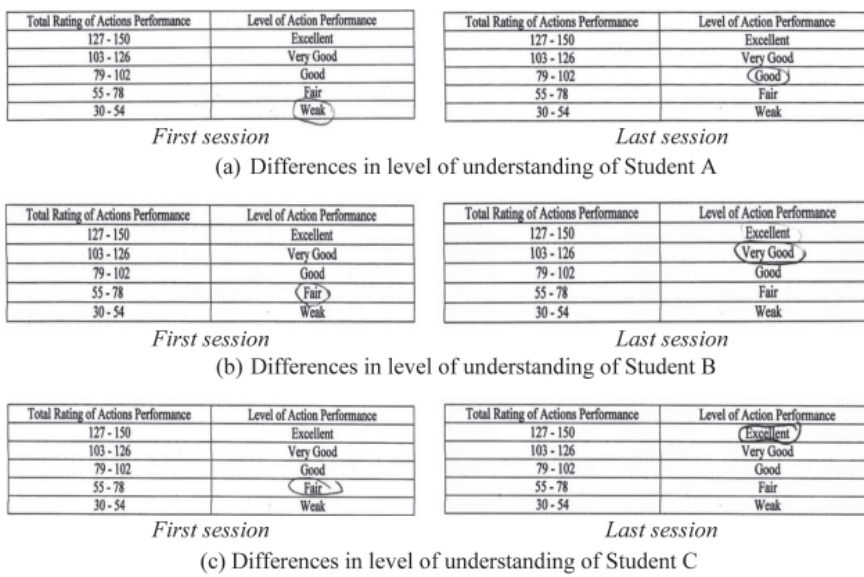


Figure 4. Data comparison on receptive vocabulary of students.

Figure 4 also shows that Student B exhibited steady improvement in understanding of text using VEKITS. Without prompting, Student B was able to independently perform most of the role play using rag doll after reading aloud the text. He could refer to the written text when he did some mistakes during role play. Student C appeared to have significant improvement in understanding the text with the use of VEKITS. She responded particularly well in comprehension activity through role play. She understood the text and

performed the accurate action without any prompt from the teacher after the third session. Teacher A highlighted the simple and repetitive text in raising the level of understanding in these students. Improvement in level of understanding in these students was further supported by the level of action performance in VEKITS running records.

Findings from Teachers in Using VEKITS

Teachers' feedback were collected through semi-structured interview, to triangulate the results from nonparticipant observation, as well as to examine the social validity of the study. Several themes were extracted from teachers' interviews.

Encourage Multisensory Teaching

VEKITS placed emphasis on integrating multisensory teaching. Teachers highlighted the use of VEKITS in providing sufficient information to the students, through various senses. The multisensory teaching had generally helped to strengthen student's mental representation during the reading process. It was evident that visual supports and kinaesthetic experiences are good ways of enhancing comprehension in students with ASD:

> *I think the multisensory concept is very suitable for students with special needs.*
>
> *(Teacher A)*

> *I definitely agree that the focuses on the tactile and sensory items in this [Good Morning book] are an advantage for students with sensory issues.*
>
> *(Teacher B)*

Improve Expressive Skills

In recounting the gains of students after the use of VEKITS, teachers observed better expressive skills in these students. When teachers introduced each prop in the first session, students were eagerly participating in naming the props. Furthermore, students were able to expand their vocabulary or ideas based on the props, even coming up with words not mentioned in the text.

> *His expressive skill was good and he often named the props before me. Sometimes he would tell me the function of the props. The first day when he saw the kitchen page, he said 'dry kitchen! Wet kitchen!'. It was great to hear that because it was a new topic in his conversation.*
>
> *(Teacher A)*

> *…When I introduced the bathroom to her [Student C], she immediately express her thought with short phrases such as 'shower', 'toilet', 'paper'.*
>
> (*Teacher B*)

Teachers' feedback on improvement in expressive skills in these students was further supported by the researcher's field notes. Students were observed to be able to express their immediate thought following the visual input they perceived. Taken together, teachers had reported various gains using VEKITS, other than gains on reading comprehension of students with Autism Spectrum Disorder.

Feasibility of VEKITS

In addition, teachers had stated the superiority of VEKITS compared to the existing reading comprehension instruction. Teachers had indicated the difficulties in their students during typical reading comprehension activity. They had highlighted the feasibility of multisensory elements to be effectively of help to their teaching, particularly the visual and kinaesthetic part of VEKITS to be strongly associated with students' knowledge of reading comprehension.

> *…It is easy to use, for me and also for the student.*
>
> (Teacher B)

> *It's difficult to build comprehension in them. When I was teaching reading comprehension before this, I drew the pictures for [Student C], tried to make the text more comprehensible. But it was still difficult for her [Student C] as she could not imagine the story from my drawing or actions...This kit is complete with all the props and setting similar to real life setting. It is so easy to use and implement in my teaching! I like the read, do, and assessment steps in your strategy. I think my students can understand the text easily because they can see [visualize] the event now.*
>
> (Teacher B)

Satisfaction and Readiness for Using VEKITS

In the interviews, both teachers highlighted their high satisfaction with VEKITS. They commended that the materials, instructions, and assessments were well designed. Teachers were delighted with the feasibility of using and understanding the instructions of VEKITS. Teachers had expressed their readiness to implement VEKITS in their daily teaching. Both teachers reported that they will continue using this strategy in teaching reading comprehension to their students with special needs.

Teachers' reports on student gains had further supported the social validity of the study and established the benefits of this intervention on reading comprehension among students with ASD. Teachers also reported that they had learnt the effectiveness of a multisensory strategy through present study. Teachers were aware that incorporating the six elements in VEKITS brought about a more vigorous effect in reading comprehension of students with ASD.

DISCUSSION

Consistent with existing research, students with ASD reflected weak reading comprehension ability. All students in the present study had earlier on exhibited Grade One reading comprehension which was below average of age-matched typically developing students. The marked degree of variation in both decoding and receptive vocabulary has primarily differentiated their overall reading comprehension. In this study, students with ASD display high level of decoding prior to and after the intervention. Besides that, the study suggests that decoding performance is correlated to reading comprehension performance. When students are familiar with the words, they can decode the words effortlessly than uncommon words (O'Connor & Klein, 2004), and understand the text with ease. Repetition of read aloud activity and use of repetitive words can eventually improve reading fluency and accuracy in these students, subsequently helping students with ASD to decode written text spontaneously.

Present study strongly agrees that difficulty to understand meaning of written words primarily affects reading comprehension of students with ASD. Students with ASD will find it strenuous to comprehend a text when they fail to understand the written word solely. Similarly, students with ASD will have a difficult time linking each word and comprehending the meaning of the sentence as a whole. All students in this study had demonstrated low level of receptive vocabulary prior to the intervention. Although they exhibited higher level of receptive vocabulary after the intervention, still, it was lower than their decoding level. The effectiveness of VEKITS in presenting the meaning of a sentence from written text into a visual representation has greatly enriched the receptive vocabulary of students with ASD. Each element in VEKITS has varied effects and its own aptness to help students with ASD to ascertain receptive vocabulary skills. Substantial use of visual supports and relative kinaesthetic experience are two major factors to enhance receptive vocabulary in students with ASD. When students with ASD assimilate the meaning of the words, they were able to comprehend the sentences as a whole.

Teachers in this study provided positive comments on multisensory teaching to improve reading comprehension of students with ASD. Through multisensory teaching, students with ASD are able to associate the text with their previous experience (Ganz et al., 2008; Stevenson, Zemtsov, & Wallace, 2012). This can help students with ASD to further explore information or events

relating to the written text. Besides, the multisensory elements of the book and the role play teaching had helped students to focus on the comprehension activity with longer attention span. The sensory intervention has helped to reduce stereotypical behavior in the students. The excitement and enjoyment in using the book might be due to its multisensory elements and the astonishing presentation. In addition, the presence of props as fidget toys has successfully promoted stable emotions in some of the students with ASD during the reading process.

Although VEKITS has implemented decontextualization using props, still, it has indirectly brought gains in practical life skills knowledge among students with ASD. The social story has educated students with ASD on sequences from waking up to getting ready for school. The thematic contents on morning routine provided students with the opportunities to integrate information from their personal knowledge to the invented situations. The role play sessions in this study not only enhance the understanding of students with ASD toward the written text, but also improved students' fine motor skills. Other than that, elements in VEKITS, especially the visual element had assisted these students to better express their immediate thought. Students in this study were able to encounter new topics to start a conversation and the researcher observed a reduction in echoing sentences from non-related advertisements or movies.

Apparently, VEKITS is a simple method to help students with ASD in comprehension. The multisensory social story enabled students to smoothly associate their previous experience and knowledge to the written text. It is always important to provide relevant reading materials to students with ASD to enable them to correlate their experience in the reading process (Basil & Reyes, 2003).

SUGGESTIONS FROM THE STUDY

This study proposed that multisensory teaching is best to present the written content in a livelier and more inspiring manner. Teachers should incorporate teaching instructions that include all senses to tackle students' individual learning styles. This will further stimulate the learning and understanding level of students with special needs, through forming mental image during the reading process. Students' performances in reading comprehension will be enhanced when they understand the contents more easily according to their preferred learning method.

To teach students with weak reading comprehension, teachers are suggested to introduce comprehension concept using written content relating to students' daily living. Students can comprehend better when the content is familiar to their daily life. Apparently, social story has been widely used in special education as students with special needs can comprehend the content easily. Teachers are advised to combine both multisensory teaching and social story

to teach reading comprehension more effectively. Teachers can escalate to variety of topics and text types when students have mastered the basic skill for reading comprehension.

More importantly, how teachers generate the comprehension activity is crucial in improving students' reading comprehension. Teachers' encouragement and creativity in conducting the comprehension activity will yield better outcomes in reading comprehension. Results from current review should benefit both mainstream teachers and special needs educators. Teachers are suggested to implement creative teaching to strategically engage students with ASD in reading comprehension.

Lastly, more attention must be paid in building substantial background knowledge in students with ASD to foster reading comprehension of various written contents. The special education field needs more research on reading comprehension interventions to help students with ASD to develop better reading comprehension.

REFERENCES

Arciuli, J., Stevens, K., Trembath, D., & Simpson, I. C. (2013). The relationship between parent report of adaptive behaviour and direct assessment of reading ability in children with Autism Spectrum Disorder. *Journal of Speech, Language, and Hearing Research, 56,* 1837-1844.

Basil, C., & Reyes, S. (2003). Acquisition of literacy skills by children with severe disability. *Child Language Teaching and Therapy, 19,* 27-48.

Bhat, P., Rapport, M. J. K., & Griffin, C. C. (2000). A legal perspective on the use of specific reading methods for students with learning disabilities. *Learning Disability Quarterly, 23,* 283-297.

Bianco, M., Pellenq, C., Lambert, E., Bressoux, P., Lima, L., & Doyen, A. L. (2012). Impact of early code-skill and oral-comprehension training on reading achievement in First Grade. *Journal of Research in Reading, 35*(4), 427-455.

Botts, B. H., Hershfeldt, P. A., & Christensen-Sandfort, R. J. (2008). Snozelen: Empirical review of product representation. *Focus on Autism Spectrum Disorder and Other Developmental Disabilities, 23*(3), 138-147.

Browder, D., Gibbs, S., Ahlgrim-Delzell, L., Courtade, G. R., Mraz, M., & Flowers, C. (2009). Literacy for students with severe developmental disabilities: What should we teach and what should we hope to achieve? *Remedial and Special Education, 30*(5), 269-282.

Campbell, A., & Tincani, M. (2011). The power card strategy: Strength-based intervention to increase direction following of children with Autism Spectrum Disorder. *Journal of Positive Behaviour Interventions, 13*(4), 240-249.

Campbell, M. L., Helf, S., & Cooke, N. L. (2008). Effects of adding multisensory components to a supplemental reading program on the decoding skills of treatment resisters. *Education and Treatment of* Children*, 31*(3)*,* 267-295.

Chiang, H. M., & Lin, Y. H. (2007). Reading comprehension instruction for students with autism spectrum disorder spectrum disorders: A review of the literature. *Focus on Autism Spectrum Disorder and Other Developmental Disabilities, 22*(4)*,* 259-267.

Clarke, P. J., Snowling, M. J., Truelove, E., & Hulme, C. (2010). Ameliorating children's reading-comprehension difficulties: A randomized controlled trial. *Psychological Science, 21*(8)*,* 1106-1116.

Flores, M. M., & Ganz, J. B. (2007). Effectiveness of direct instruction for teaching statement inference, use of facts, and analogies to students with developmental disabilities and reading delays. *Focus on Autism Spectrum Disorder and Other Developmental Disabilities, 22*(4)*,* 244-251.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education* (8th ed). New York, NY: McGraw-Hill.

Gabig, C. S. (2010). Phonological awareness and word recognition in reading by children with Autism Spectrum Disorder. *Communication Disorders Quarterly, 31*(2)*,* 67-85.

Ganz, J. B., Bourgeois, B. C., Flores, M. M., & Campos, B. A. (2008). Implementing visually cued imitation training with children with Autism Spectrum Disorder Spectrum Disorders and developmental delays. *Journal of Positive Behavior Interventions, 10*(56)*,* 56-66.

Guo, Y., Roehrig, A. D., & Williams, R. S. (2011). The relation of morphological awareness and syntactic awareness to adults' reading comprehension: Is vocabulary knowledge a mediating variable? *Journal of Literacy Research, 43*(2)*,* 159-183.

Hua, Y. J., Hendrickson, J. M., Therrien, W. J., Woods-Groves, S., Ries, P. S., & Shaw, J. J. (2012). Effects of combined reading and question generation on reading fluency and comprehension of three young adults with autism spectrum disorder and intellectual disability. *Focus on Autism Spectrum Disorder and Other Developmental Disabilities, 27*(3), 135-146.

Huemer, S. V., & Mann, V. (2010). A comprehensive profile of decoding and comprehension in autism spectrum disorder spectrum disorders. *Journal of Autism Spectrum Disorder and Developmental Disorder, 40,* 485-493.

Joshi, R. M., Dahlgren, M., & Boulware-Gooden, R. (2002). Teaching reading in an inner city school through a multisensory teaching approach. *Annals of Dyslexia, 52,* 229-242.

Kendeou, P., Broek, V. D. P., White, M. J., & Lynch, J. S. (2009). Predicting reading comprehension in early elementary school: The independent contributions of oral language and decoding skills. *American Psychological Association, 101*(4)*,* 765-778.

Kerins, M. R., Trotter, D., & Schoenbrodt, L. (2010). Effects of a tier 2 intervention on literacy measures: Lessons learned. *Child Language Teaching and Therapy, 26*(3)*,* 287-302.

Mucchetti, C. A. (2013). Adapted shared reading at school for minimally verbal students with Autism Spectrum Disorder. *Autism Spectrum Disorder, 17*(3)*,* 358-372.

Nation, K., Clarke, P., Wright, B., & Williams, C. (2006). Patterns of reading ability in children with Autism Spectrum Disorder Spectrum Disorder. *Journal of Autism Spectrum Disorder and Developmental Disorder, 36,* 911-919.

Nelson, J. R., Benner, G. J., & Gonzalez, J. (2005). An investigation of the effects of a prereading intervention on the early literacy skills of children at risk of emotional disturbance and reading problems. *Journal of Emotional and Behavioral Disorders, 13*(1), 3-12.

Oakley, G., Howitt, C., Garwood, R., & Durack, A. (2013). Becoming multimodal authors: pre-service teachers' interventions to support young children with Autism Spectrum Disorder. *Australasian Journal of Early Childhood, 38*(3), 86-96.

O'Connor, I. M., & Klein, P. D. (2004). Exploration of strategies for facilitating the reading comprehension of high-functioning students with Autism Spectrum Disorder. *Journal of Autism Spectrum Disorder and Developmental Disorders, 34*(2).

Online Curriculum Resource. Retrieved from https://www.readinga-z.com/books/leveled-books/

Randi, J., Newman, T., & Grigorenko, E. L. (2010). Teaching children with autism spectrum disorder to read for meaning: Challenges and possibilities. *Journal of Autism Developmental Disorders, 40*(7)*,* 890-902.

Reading Horizons. (2014). Orton-Gillingham method: A brief history of the teaching reading method. Retrieved from http://athome.readinghorizons.com/research/orton-gillingham-history.aspx

Ricketts, J., Jones, C. R. G., Happe, F., & Charman, T. (2013). Reading comprehension in autism spectrum disorders: The role of oral language and social functioning. *Journal of Autism Developmental Disorders, 43,* 807-816.

Speirs, S., Yelland, G., Rinehart, N., & Tonge, B. (2011). Lexical processing in individuals with high-functioning Autism Spectrum Disorder and Asperger's Disorder. *Autism Spectrum Disorder, 15*(3)*,* 307-325.

Stevenson, R. A., Zemtsov, R. K., & Wallace, M. T. (2012). Individual differences in the multisensory temporal binding window predict susceptibility to audiovisual illusions. *Journal of Experimental Psychology: Human Perception and Performance, 38*(6), 1517-1529.

Turkeltaub, P. E., Gareau, L., Flowers, D. L., Zeffiro, T. A., & Eden, G. F. (2003). Development of neural mechanisms for reading. *Nature Neuroscience, 6*(6)*,* 767-773.

Wei, X., Christiano, E. R., Yu, J. W., Wagner, M., & Spiker, D. (2015). Reading and math achievement profiles and longitudinal growth trajectories of children with an Autism Spectrum Disorder. *Autism, 19*(2), 200-210.

Whalon, K., & Hart, J. E. (2011). Adapting and evidence-based reading comprehension strategy for learner with Autism Spectrum Disorder. *Intervention in School and Clinic, 46*(4), 195-203.

Whalon, K. J., Otaiba, S. A., & Delano, M. E. (2009). Evidence-based reading instruction for individuals with Autism Spectrum Disorder. *Focus on Autism Spectrum Disorder and Other Developmental Disabilities, 24*(1), 3-16.

Wright, C., Conlon, E. G., Wright, M., & Dyck, M. H. (2011). An open, pilot study of the understanding words reading intervention program. *SAGE Open, 1,* 1-11.