

Digital Stories in Writing Instruction for Middle School Students With Autism

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Received 15 April 2014; accepted 26 June 2014
Publish online 27 August 2014

Abstract

The purpose of this study was to examine the effect of computer-assisted writing instruction using digital stories for middle school students with autism. Four students diagnosed with Autism Spectrum Disorders (ASD) participated in the study. A single-subject, multiple-baseline research design across students with ABC phases was used to evaluate students' learning. During the baseline, students were assigned topics for free writing. During the intervention, digital pictures were presented to teach students to develop six compositions following the four stages of writing, including planning, drafting, editing and publishing. Each composition was evaluated by teachers to record total number of written words, correct words, and complete sentences as well as writing quality. Subsequently, the students were assigned to develop their own digital stories for two selected topics to evaluate their skill maintenance. Results showed that the students increased their number of written words and complete sentences when computer-assisted digital stories were applied within writing instruction. It indicates that using technology in writing instruction has potential to support students with autism.

Key words: Digital stories; Middle school students; Autism; Writing Instruction

Xin, J. F. (2014). Digital Stories in Writing Instruction for Middle School Students With Autism. *Studies in Literature and Language*, 9(1), 1-10. Available from: <http://www.cscanada.net/index.php/sll/article/view/5180>
DOI: <http://dx.doi.org/10.3968/5180>

INTRODUCTION

Writing is an important medium for students to communicate their thoughts, feelings, and beliefs (Graham & Perin, 2007). With the development of new media using technology, writing is necessary for many tasks of daily lives, such as for communicating with family members and friends via websites, e-mails, and social media via Facebook. However, writing performance of many adolescents is below the level of required proficiency as indicated in the report of the National Assessment of Educational Progress (Cited in Asaro-Saddler & Saddler, 2010). This report indicates that 69-77 percent of students in 4th, 8th, and 12th grades did not meet writing proficiency goals. To improve adolescents' writing skills, writing has become an integral part of the middle school and high school's curriculum as required in all state standards in the United States. For example, writing is one of the curriculum standards required by the state of New Jersey, and assessed on the state-wide standardized test annually (New Jersey Department of Education, 2009). The high-stakes writing tests typically require students to write to a specific prompt without a choice of topics. Thus, teaching expressive writing about a topic seems especially important for students. Yet, writing is a difficult subject area or skill for students, especially for those with disabilities. Writing has become extremely difficult for students with communication problems (Lindgre, Folstein, Tomblin, & Tager-Flusberg, 2009), language learning disabilities (Gersten & Baker, 2001; Baker, Gersten, & Graham, 2003), specific language impairments (Kjelgaard & Tager-Flusberg, 2001), as well as autism spectrum disorders (ASD) (Asaro-Saddler & Saddler, 2010; Pennington & Delano, 2012).

Students with ASD demonstrate communication problems in both oral and written formats (Autism Society

of America, 2008; Lindgre, Folstein, Tomblin & Tager-Flusberg, 2009) in that, they exhibit a wide variety of characteristics that may severely impact on their abilities to express themselves, especially in writing. These include literal thinking, lack of brainstorming ideas, and difficulty imagining possible events and scenarios (Pennington & Delano, 2012; Pennington, Stenhoff, Gibson, & Ballou, 2012). Lack of abilities to elaborate their thoughts and feelings is another factor that makes their writing too short and simple with inappropriate descriptions (Anzalone & Williamson, 2000; Jansiewicz et al., 2006). In addition, lack of organizational skills often makes it difficult for these students to transfer their thoughts to paper, making their compositions difficult to understand (Asaro-Saddler & Saddler, 2010). Overall, written expression is an area that is especially challenging students with ASD.

Although developing writing skills is a challenge, the acquisition of these skills is important for students with ASD in a variety of contexts to express their idea and enhance their function in school. For example, they may need to write a note for direct requests, engage in social conversations, create compositions to express their feelings, and to communicate with others using a written format. According to Pennington et al. (2012), “the acquisition of story writing is critical to students with ASD, because: (a) Story generation is a valuable social skill and may be used by individuals to access praise and reinforcement from peers and adults, (b) story writing may serve as a context for the instruction of other important skills (e.g. grammar, spelling, syntax, perspective taking, communication), and (c) story writing is required to students without disabilities from kindergarten to secondary educational settings” (p.391). Thus, writing instruction is critical to students with ASD to learn written English language and to improve their writing skills.

Graham and Perin’s analysis of research (2007) related to student’s writing instruction indicates that the explicit teaching process for writing strategies is a basic teaching method with the following four stages: planning, drafting, revising and publishing. Teachers, therefore, need initially to model the writing process of each of these stages, and guide students in applying and working toward independence. Although this explicit instruction through these stages in writing has proven effective for students in general (Graham & Perin, 2007), little research has been conducted relating effective writing instruction for students with ASD. Even though, current estimates indicate that one in 110 children in the United States is diagnosed with ASD (Center for Disease Control, 2010), and more and more students with ASD are included in classrooms where they have access to the general education curriculum. Therefore, it seems imperative for teachers to learn and to understand how to effectively teach these students to express their thoughts in written formats. To date, research on writing instruction for students with ASD is limited. Few studies were conducted

with limited number of participants with ASD and limited writing instruction across writing skills. Although story writing was taught to children with ASD in prior research (e.g. Asaro-Saddler & Saddler, 2010; Pennington et al., 2012), a lack of participants from middle school and high school was often found. In addition, there are limited studies to replicate any interventions in the area of writing to be considered as an evidence-based practice (Gersten, et al., 2005). Therefore, research is needed in writing instruction, especially for students with ASD.

According to Ganz, Earles-Vollrath and Cook (2011), visually based instruction, such as using computer programs to demonstrate visual images is preferred by students with ASD. These students are known to be visual learners (Pennington et al., 2012). Therefore, a visually based approach often assists them to focus and maintain their attention (Simpson, Myles, & Ganz, 2008). Thus, their abilities to independently complete unfamiliar tasks are enhanced through visual cues (Ganz, Earles-Vollrath, & Cook, 2011). The nature of visually based instruction should allow these students to review visual cues and to make abstract concepts concrete, which are especially beneficial to students with ASD who often have difficulty processing normally presented auditory information (Mechling & Savidge, 2011). Successful approaches to instruction may include pictures and photos in teacher’s lectures and students’ practice through class activities.

A story presented on a computer screen with visual images is referred to a digital story (Shin & Park, 2008). Such a digital story often includes multimedia texts consisting of still images complemented by a narrated soundtrack to orally tell the story. Computer programs such as iMovie on Mac computers and MovieMaker on Windows of PC computers present user-friendly options to develop digital stories. An example that is easily accessible is found in “PhotoStory”, a free application from Microsoft available for use in the Windows platform (<http://www.microsoft.com/download/en/details.aspx?id=11132>). This program allows users to post, move, rotate, and save digital pictures, texts, and recorded voices, in order to produce a story in a slideshow format. Thus, users are able to add stunning special effects, soundtracks, and voice narrations to their photo story, as well as titles and captions. According to Sylvester and Greenidge (2009), developing digital stories motivates students to engage in class activities, because these stories provide an alternative conduit of expression for those who struggle with writing traditional text materials. Computer-assisted instruction with digital images serves as visual cues to support students in brainstorming, expanding, and organizing ideas (Sylvester & Greenidge, 2009). This application of computer-technology as a learning medium presents materials in a series of visual cues to benefit learners with disabilities in learning difficult subjects, such as writing (Pennington et al., 2012).

The purpose of this study was to examine the effects of computer-assisted digital stories created in teaching

expressive writing to students with ASD. It attempted to extend previous research in two important ways. First, the participants were middle school students with ASD instead of children in elementary schools as most studies had focused previously. Second, this was the first study to evaluate if students with ASD could develop their own digital stories to improve their writing skills in terms of the number of written words (TW), correct words (CW), complete sentences (CS), and general writing quality (QW), although digital stories were used in writing instruction for college students (Xu, Park, & Baek, 2011) and students without disabilities in foreign countries (Sadik, 2008).

1. METHODS

1.1 Participants and Setting

Students. Four male middle school students diagnosed with ASD participated in the study. Their ages ranged from 13-14 years. They had deficiencies in English language development in reading and writing, though they were able to write independently with a pencil or pen. They were attending an alternate school for students with disabilities and placed in the same class for learning language. The writing instruction was provided during an entire semester of 5 months in the school year. To verify the students' writing abilities, Test of Written Language, 4th edition was given before the instruction, and the writing subtest, Story Construction was administrated by the teacher who was trained in the graduate course of Assessments. This subtest assesses a student's ability to compose complete stories by determining if some required elements are presented. During testing, students were asked to write a story about a picture prompt. Their standard scores were between 7 and 8, which were below the mean of 10, indicating 2 standard deviations below the mean. In addition, all participants were diagnosed with ASD prior to their elementary schooling and their individual education programs' (IEPs) goals and objectives include both expressive and written language development. Table 1 presents general information of the participating students.

Table 1
General Information of Participating Students

Student	Current age	Ages of diagnosis	NJASK writing (M=200)	TOWL4 (M=10)	TOWL4 (percentile)
1	13	4	115(pp)	7	16
2	13	3	155(pp)	7	16
3	14	4	159(pp)	8	25
4	14	4	152(pp)	7	16

Note. NJASK: New Jersey Assessment of Skills and Knowledge; PP: Partially Proficient.

Student 1, Mark, received special education services including speech, language, and occupational therapy.

This 13 year old had difficulty in reading and spoken language. As the teacher reported, Mark also had difficulty in expressing his ideas orally to others. Student 2, Bob received special education services since 3. He was 13 and liked to talk to himself. He had a problem understanding printed text. The difficult task for him was to express himself in a written format. Student 3, Eric, 14 years old, began receiving services including speech and language therapy since 4. He was transferred from the general education program to the special education since 4th grade because of his delay in language development. Student 4, Josh, was 14 years old. He started receiving services in special education, and speech and language therapy since 4. The teacher reported that Josh had difficulty in both oral and written language expressions, especially in the areas of syntax and vocabulary, such as completing a sentence with correct words.

Teacher. A special education teacher implemented the lessons, evaluated each student's stories, and recorded their scores. She has been teaching middle school students with disabilities for several years. At the time of the study, she was enrolled in graduate level studies designed to fulfill the requirement of a thesis for an advanced degree in the area of special education.

1.2 Research Design

A multiple baseline research design across students with ABC phases (A: baseline, B: intervention, C: maintenance) was used to evaluate the four students' performance. Such a single-subject design documents experimental control, like randomized control-group design that can be used to establish evidence-based practices (Horner, Carr, Halle, McGee, Odom & Wolery, 2005). In single subject research, each participant serves as his/her own control. Performance prior to intervention is compared to performance during and/or after intervention.

During the baseline (prior to the intervention), the students were given a topic with a picture prompted for free writing. Two stories were assigned to two students, and three for the others to measure their narrative writing abilities to obtain their performance level. The total number of words written (TW), correct words (CW), complete sentences (CS), and writing quality (QW) was recorded for each story. During the intervention, computer-assisted instruction using digital stories was provided, and six stories were developed with one story in two weeks. All students were taught in a group following the lessons in the Instructional Procedures, while the first two students were guided by the teacher to complete and present their composition one week ahead of the others. Two weeks after the intervention, each participant was administrated two story writing task using the digital story program to measure their achievement level. These stories were written without the teacher's modeling, but students developing their own stories assisted by the instructor if needed. This research design was considered due to the

limited sample size of students with ASD with similar characteristics, and the instruction designed with individual assistance in writing activities using the computer program.

1.3 Dependent Measures

Data were collected on four dependent variables: a total number of words written (TW), correct words (CW), complete sentences (CS), and writing quality of each story (QW) to evaluate student performance. All of these measures are commonly used in writing research (e.g. Asaro-Saddler & Saddler, 2010).

(a) Total number of words. The teacher manually counted each word in each story, and recorded in a sheet. If a word had one character long and separated from other characters by a space, this word would be considered as one number. The story titles were not included, because they were presented by the teacher on the board for the

students to copy. The same method was used to count correct words, and complete sentences. Scoring was checked by a fellow teacher to obtain at least 90% of an agreement for the inter-rater reliability.

(b) Quality of Writing. A rubric (Table 2) was developed by the teacher based on the state standard in the subject of writing using an 8-point scale to match with the work by Graham and Harris (1989). The scores ranged from 1 to represent the lowest in writing quality, to 8, the highest. The teacher read each story for an overall writing quality focusing on ideation, organization, sentence structure, grammar, and vocabulary. Then, another teacher would read the story again discussing together with the previous teacher for the final score. If there was any discrepancy between the two teachers, a third teacher would be invited to discuss the score.

Table 2
Rubric for Writing Quality

Elements	8	7	6	5	4	3	2	1
Meaning/Ideas: The extent to which the response exhibits understanding and interpretation of the task and text(s)	Response was very clear, it holds attention, is easy to understand and rich with elaborations and details.	Response was clear and understandable it has limited details and elaborations	Response lacks clarity, support and expansion were attempted, but story line was confused by irrelevant details	Response was adequate but lacks elaboration of ideas and details	Response was adequate but lacks relevant details	Response to topic was limited and lacks organization	Response was a collection of random topic ideas	Response was off topic
Language Use: The extent to which ideas are elaborated using specific and relevant evidence from the text(s)	Language was adequate, correct and varied, words were specific and relevant to the text(s)	Language was adequate, correct and varied, word were specific and/or relevant to the text(S)	Language was adequate and correct, but lacks elaboration and relevance	Language was basic in context, lacking in elaborations and relevance	Language was basic, but used in the wrong context	Language was basic, vague and immature, the context was inappropriate	Language was basic, lacking context and variations	Language was inappropriate, meanings are inaccurate,
Organization: The extent to which the response reveals an awareness of audience and purpose through effective use of words, sentence structure, and variety.	Organization was logical, flows smoothly, is thoughtful and appropriate for the audience	Organization was logical and appropriately guides readers through the text	Organization was recognizably structured from its introduction to its conclusion	Organization was present, but connections between ideas may be unclear at times	Organization was unclear; it lacks appropriate connections and transitions between ideas.	Organization was limited, it lacks a clear sense of direction	Organization was absent ideas appear to be randomly strung together	Organization was not present making it difficult to determine the main point
Sentence Structure: The extent to which the response exhibits appropriate sentence structure	Sentences were well-constructed, response contains an appropriate variety of sentence structures	Sentences were natural and the structures were adequately varied	Sentences were generally correct but limited in variety	Sentences were natural and the structures were adequately varied	Sentences were generally correct but limited in variety	Sentences were simple, and had numerous errors	Sentences were incomplete, fraught with errors and did not make sense	Sentences were nonexistent
Conventions measures: The extent to which the response exhibits conventional punctuation, paragraphing, capitalization, grammar, and usage	Convention control was strong evidenced by correct word usage, punctuations, paragraphing, capitalizations and grammar	Conventions were mostly accurate in the areas of word usage, punctuation, paragraphing, capitalizations and grammar	Conventions had minimal errors in word usage, punctuation, paragraphing, capitalization and grammar	Conventions were very limited, exhibiting errors in word usage, punctuation, paragraphing, capitalization and grammar	Conventions were inadequate and interfered with comprehension.	Conventions were very limited, evidenced by errors, which interfered with comprehension	Conventions were weak evidenced by numerous errors that prevented comprehension	Conventions were nonexistent

1.4 Data Analysis

A visual analysis of the scores of each story presents the baseline, intervention and maintenance for each participating student (Figure 1). In addition, the percentage of non-overlapping data (PND) procedure described by Scruggs, Mastropieri, and Casto (1987) was used. This type of analysis is commonly applied in single-subject research design and has been proven to detect intervention effects (Campbell, 2004). The guideline recommended by Asaro-Saddler and Saddler (2010) was adopted, indicating 90% of the intervention points exceeding the extreme baseline value for a very effective treatment; 70% to 90%, an effective treatment; 50% to 69%, a questionable treatment, and less than 50%, an ineffective treatment (See Table 3).

The writing instruction for all four students was provided during the entire semester following the four stages of the writing process indicated below.

Planning. This first stage known as “knowledge-telling” involves writing down all information that is perceived to be related to the topic (Santangelo, Harris & Granham, 2008). To support students in generating ideas, the teacher first created a digital story using “Microsoft, Photo Story 3” downloaded to her computer and the students’ computers. The teacher then developed a slideshow incorporating the following five elements of a writing sample, including the main character(s), a description of the time of the story, a description of where the story takes place, what the character(s) does or wants to do, what happens after that, and how the story ends (indicating who, when, where, what and how). Thus, a total of five “pictures” were compiled to construct the story to a slideshow, using the teacher’s voice to narrate each slide of the picture to tell the story, as well as typed texts presented simultaneously. This planning stage included two lessons described as follows.

(a) First Lesson. The teacher asked questions verbally related to telling the story. For example, what we should tell the audience, leading into the parts of a story through inclusion of who, when, where, what, and how (WWWWH). Each student practiced each of the components to understand what each stood for and its importance in telling the story. Then, the teacher led a class discussion about something in student lives they wanted to tell as a story. The class agreed to pick one topic as a writing assignment. To encourage student brainstorming about what to write, the teacher demonstrated her story with the assigned topic by showing the slideshow as a model with her voice recorded to tell the story. The voiced narratives along with the text presented how to transcribe the visual pictures into textual writing in sentences. For example, “My Family” was used as a model. The teacher showed a digital story slide by slide about WWWWH for students to identify each part of the story, and to fill out each component in their worksheet (see Story Parts). In

addition, the teacher demonstrated more pictures that could be added to describe “My Family”, for example, a picture of a family pet or a picture of a job occupation, to develop narratives to expand the story writing. The same process was used to develop other stories, e.g. my school, my community, and my friends that were the topics students selected for their writing.

Story Parts:

Who is in my family? _____
Where does my family live? _____
When was the family party? _____
What did we do at the party? _____
How did the party end? _____

(b) Second Lesson. Each student turned on his computer to review the digital story developed by the teacher. The teacher guided students to read together and review the five components of the story (WWWWH). Then, the teacher introduced the planning stage of writing to demonstrate a checklist of writing steps (Four Writing Stages). The class discussed the first step using a mnemonic device (POT). This device was adapted from the study by Asaro-Saddler and Saddler (2010). This mnemonic phrase is indicated below.

Pick my idea (decide what I want to write about),

Organize my idea in pictures (search online and select pictures about what I want to include, and organize in sequence),

Think about my idea and search for more pictures.

The teacher explained the mnemonic phrase of POT and its importance. Then, students practiced the mnemonic until they understood. This was followed by reviewing students’ previous worksheet with story parts (see Story Parts), and students were asked to brainstorm their ideas to make up a story with pictures, and to fill out their idea in the worksheet, and to get ready to search online for pictures for their own story.

Four Writing Stages:

Stage 1: Planning

Pick your idea

Organize your idea in pictures

Think more and say more

Stage 2: Drafting

Put the information you learned in your own words

Write sentences and paragraphs

Read what you have written and be certain that it says what you mean

Stage 3: Revising

Read what you have written again

Be certain that words and sentences are understandable

Correct spelling, capitalization, and punctuation

Stage 4: Publishing

Present your story to the class

Read your journal aloud

Congratulate yourself on a job well done

Drafting (The second stage of writing). This stage includes two lessons:

(a) First Lesson. The teacher guided each student to develop his own story by compiling obtained pictures through the planning stage. For example, the first picture might show who is in the family, the second picture might include a house, and the third might be a family activity, the fourth might show a family get-together, etc. Students were guided to post the pictures, then say something verbally about each picture to respond to each of five component, WWWWH. They could either post their own pictures or search online for pictures related to the story. Their verbal narratives were recorded individually. Subsequently, they listened to their own voices using an ear phone. The teacher would encourage each student to say more about each picture he could add more to his story.

(b) Second Lesson. Each student reviewed his story through the computer by listening to his own voices. Each was guided to type what he said at the bottom of each picture to respond to each part of the story as mentioned above (WWWH). The teacher encouraged students to write in their own words by typing a sentence and read what they had typed to be sure it says what they meant to say. The teacher provided assistance as needed and encouraged students to expand their writing.

Revising. At this stage, each student reviewed his own written story on the computer screen. Students were guided to copy and post their writing into a page to complete the assignment as a journal. They were assisted by the teacher to check capitalizations, spelling and punctuations using a checklist (Checklist). This was followed by individual student-teacher conferences during which, the students read their completed written story to the teacher. The teacher gave comments and pointed out any mistakes. Students corrected mistakes and revised as needed.

Checklist (Checking each item as you read your story)

- _____ I started my sentence with a capital letter.
- _____ I used punctuations.

- _____ I checked my spelling.
- _____ I re-read my story
- _____ I made corrections

Publishing. At this stage, students presented their story slide by slide on the computer screen to their peers. They also read the story aloud to the class, and were guided to print out the written story in a hard copy for the teacher. Each story was completed in about two weeks, and the second story was introduced for the following weeks with a total of six stories developed during the instruction.

2. RESULTS

The writing lessons referred to above were provided to the students with ASD using the digital stories by a special education teacher. The students made progress in their writing including an increase of total number of words, complete sentences, and correct wording. In addition, the quality of their writing was improved comparing to their written assignments prior to the instruction.

Number of words. All participating students increased total number of words from the baseline to intervention (see Story Parts). For example, Mark, wrote an average of 10.5 words (11 for the first story, 10 for the second) during the baseline, and an average of 14.5 words (10, 12, 15, 10, 19, and 19 for the six stories respectively) during the intervention. His total number of words written was maintained to 18 and 19 for the two additional stories with an average of 18.5 words at maintenance, with PND of 70% indicating an effective treatment. Bob wrote an average of 10 words during the baseline and increased to an average of 15.5 words (11, 13, 15, 14, 25, & 20) during the intervention with PND of 100% indicating a very effective treatment. His final two stories had 20 and 24 words at maintenance. Eric, increased his number of words from an average of 16.5 (15, 18, 17) to 20.5 (15, 15, 22, 22, 30, & 26). Josh increased from an average of 12 (11, 12, 13) to 25 words (20, 16, 25, 25, 33, & 30) with PND of 100% as well, indicating a very effective treatment (Table 3).

Table 3
Means, Standard Deviations, and Percentages of Non-Overlapping Data for Participating Students Across Phases

Student/phase	TW		CW		CS		QW	
	M	SD	M	SD	M	SD	M	SD
Baseline (Mark)	10.5	.58	10	1	33	.58	1	0
Intervention	14.1	4.12	9.33	1.03	2.8	1.17	3	.89
Maintenance	18.5	.71	10.5	.71	4	0	4	0
PND	70		0		80		100	
Baseline (Bob)	10	0	4.5	.71	2	.71	1.5	.71
Intervention	15.5	6.36	15	7.07	3.5	2.12	3.5	2.12
Maintenance	22	2.83	19	1.41	5.5	.71	5	0
PND	100		100		75		80	
Baseline (Eric)	16.5	2.12	10.5	.71	3.5	.71	2.5	.71
Intervention	20.5	7.78	17	9.9	5.5	.71	5.5	2.12
Maintenance	28.5	2.12	24	1.41	5.5	.71	6	0
PND	75		75		100		100	
Baseline (Josh)	11.5	.71	5.5	.71	0	0	1	0
Intervention	25	7.17	22	9.9	6	1.41	5.5	2.12
Maintenance	32.5	.71	24.5	.71	6.5	.71	6.5	.71
PND	100		100		100		100	

(Note: TW: total words; CW: correct words; CS: complete sentences; QW: quality of writing)

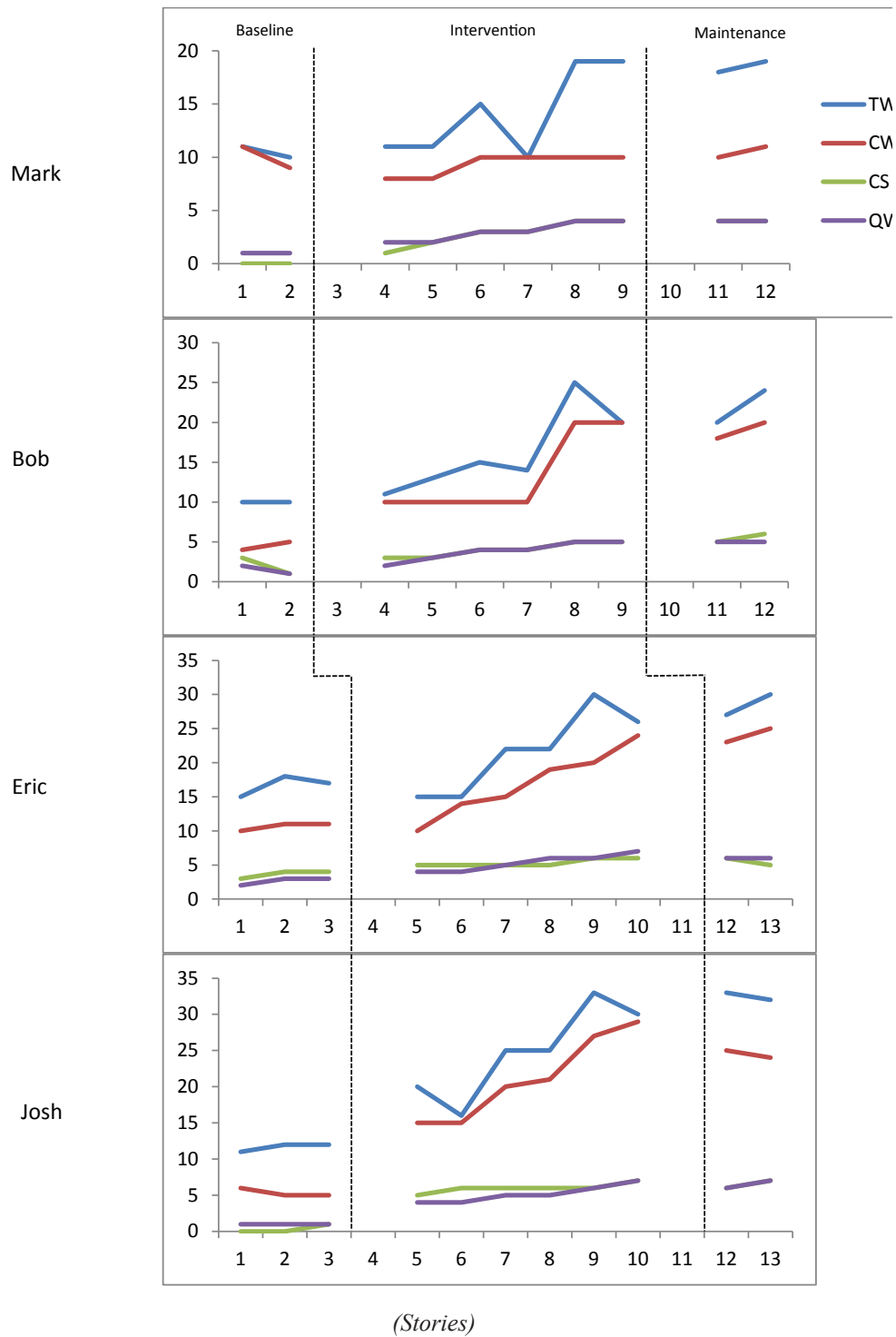


Figure 1
Individual Student Performance

Number of correct words. Words were counted as being correct when they were grammatically correct with correct spelling. This is difficult for some students with autism (Kushki, Chau, & Anagnostou, 2011). In the study, Mark, Student 1, was not improving his spelling skills, but keeping the similar number of correct words in his writing. Bob increased his correct words to 15 (10, 10, 10, 10, 20, & 20) and maintained at 19. Eric increased

to an average of 17 (10, 14, 15, 19, 20, & 24) and 24 at maintenance. Josh improved his word writing to an average of 22 correct (15, 15, 20, 21, 27, & 29) and 24 at maintenance. Except Mark, no effect in correct word writing, the rest of students' PND ranged from 75% to 100%, indicating an effective treatment (Table 3).

Number of complete sentences. Each student increased their writing of complete sentences when the digital

stories were used. For example, Mark increased his written sentences with an average of 2.5 (1, 2, 3, 3, 4, & 4), and maintained at 4, while none complete sentence was found during the baseline. Bob increased to an average of 3.5 (2, 3, 5, 5, 6, & 5), and wrote 5 and 6 complete sentences at maintenance. Eric improved his sentence writing to an average of 5.5 (5, 5, 5, 5, 6, & 6) during the intervention and 5 and 6 at maintenance. Josh's complete sentences increased to 6 (5, 6, 6, 6, 6, & 7) and he wrote 6 and 7 complete sentences at maintenance. Four students' PND ranging from 75% to 100% indicated an effective treatment (Table 3).

Quality of Writing. During the baseline, the students were given a topic selected for free writing, their scores of writing quality ranged from 1 to 2.5 evaluated based on the Rubric (see Table 2). During the intervention, the computer-assisted digital stories were used and students were guided to develop six stories with different topics they selected, following the four instructional stages mentioned above. Their scores increased with a range of 3 to 5.5. For example, during the baseline Mark's writing quality was scored 1, while the instruction was provided with digital stories in the intervention, his score increased to 3. Bob's scores increased from 1.5 to 3.5. Eric improved his writing from 2.5 to 5.5, and Josh from 1 to 5.5 (Table 3). The PND of 80% and 100% indicated that using the computer-assisted digital stories is an effective treatment to improve the students' writing.

3. DISCUSSION

Students with ASD often experience deficits in cognitive, linguistic and motor processes simultaneously that are required in writing. They lack of communication skills, and understanding of others, while writing requires communicative actions in a social dialogue between the writer and the audience. Thus, writing a composition is challenging these students. Teaching their writing skills is another challenge for teachers because there was not a designated writing instruction for students with ASD. The purpose of using digital stories is to support these students in developing appropriate writing skills using the four stages of writing process to plan, draft, revise, and publish their written compositions. Digital stories provided visual images for these students to brainstorm their idea, and expand their thinking, then say something about the visual pictures to help them transcribe their thoughts into writing. The sequence of the visual pictures in a digital story also helped these students organize their idea including each part of the event, i.e. who, where, when, what and how, into a logical sequence. The results showed that all participating students expanded their writing by increased number of words and complete sentences, which was leading to the improvement of writing quality. Despite one student who maintained a similar number of correct words written, the other students also improved their skill

of using correct words in their writing with the computer. All participants were able to learn how to develop their own stories by posting their own pictures, finding pictures by searching Internet, and recording their voice to describe their stories. This learning by doing activity reinforced their learning and motivated them to expand and organize their ideas for writing. In addition, the voiced narratives in recording helped these students to transfer their ideas into written text, which is one of the difficult tasks for students with disabilities (Santangelo, Harris, & Granham, 2008). As a result, students were motivated to write their stories, and, thus to create an opportunity to practice their writing skills.

Results of this study yielded a new finding for the literature. The computer-assisted instruction using digital stories in writing instruction was an effective approach to middle school students with ASD for increasing their writing words and correct sentences, thus, to improve their writing quality. In addition, the computer program provides an opportunity for students to type words and check for spelling. This helps students with ASD overcome handwriting problems, because handwriting is problematic for these individuals (Kushki, Chau, & Anagnostou, 2011). Despite the positive results, it is found that none of the participating students reached the highest score of 8 ranked in the rubric for their writing quality. This may mean that writing needs longer time to practice to improve quality, which should be an important goal in writing instruction. Teachers need to guide students in practices and provide assistance in the editing stage, thus, their writing quality could be improved. The revision process is an important step in the writing process that requires writers to "re-think" their writing by editing and re-reading their composition many times, and at the same time to evaluate how effectively their writing communicates their intent to the readers. These students often view the revision process as merely a time to correct mechanical and spelling errors, failing to realize the important of revising and refining content. Therefore, their composition may lack unity, clarity, development, emphasis and diction. Thus, this area may need to be emphasized in writing instruction, especially for students with ASD.

Limitations. Although this study provides positive results to the field of technology-based instruction and instructional approaches to students with ASD in learning written English, there are some limitations. First, the small sample size of four participants in the study may produce a threat to the validity. Future research to include a larger student sample is needed to validate the finding. Second, the study was conducted in a special education classroom for students with disabilities, and all participants were taught by a single teacher. Other learning environment such as inclusive classrooms should be considered for future studies on students with ASD. In addition, there are many different computer programs available to develop digital stories, but this study only used Microsoft Photo Story, a free online program. Other programs to create

different digital stories should be used to validate the program appropriateness and quality.

Implications. Computer-assisted instruction using digital stories may facilitate student learning, especially learning a difficult subject such as writing. Using technology will increase student's interests in the learning process, because they have to pull down the menu bar, to search, and to select pictures for their stories. This learning by doing activity engages students in writing process and increases their interests in completing their writing assignments, which is important for adolescents with disabilities. There are many examples of digital stories online that will be helpful for teachers to create their own stories for their students. For example, www.storycenter.org is a website presenting articles and examples of digital stories; www.coe.uh.edu/digitalstorytelling/examples.htm is a website developed by the University of Houston for digital stories including tutorials, examples, software, and other resources; and techteachers.com/digstory/examples.htm provides a list of websites for teachers to search and view examples. The computer program, "Microsoft, Photo Story 3" is free online to be downloaded by any teacher to use in classrooms. It is anticipated that teachers should become aware of these resources, and create their own instruction using technology. Today, many education settings include computer equipment and programs that can be selected for teaching writing to all students, especially to those with disabilities. The experiences reported herein indicate that the more teachers who learn to develop technology-based instruction, the more students with disabilities will benefit. There is great potential for teachers to design instruction to engage their students in learning skills of a challenging subject area such as writing, especially for those with autism.

ACKNOWLEDGEMENT

The author acknowledges the contributions of Michele Andreevski who assisted with the lesson implementation and data collection of the study, and Dr. Frank X. Sutman for his review and comments on the report.

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