The Using Web-based Animated-tutors to Improve Word Recognition for Children with Autism Spectrum Disorders

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ABSTRACT
A variety of different technologies are used to intervene in children with autism spectrum disorder (ASD) increasingly every year as more and more children are diagnosed with ASD. One of the technologies used is the use of images, multimedia, and animation with the help of computer technology to provide interventions of different abilities to ASD children. The use of animation provides significant benefits for children such as its use can be anywhere, anytime, and can be done by parents without having to be guided by a teacher or therapist. This study presents an early version of an animation tutoring application for ASD children by using web technology and the Picture Exchange Communication System (PECS) learning method. Currently, the application developed is the first level of the six phases of learning the PECS model. The development of this animated tutoring application is to aid and support teachers and speech therapists of ASD children by providing an interactive learning environment for children. The test is conducted by dividing it into three stages, namely pre-test, assessment, and post-test. The test results showed that there was an increase in vocabulary proficiency by 83%. This shows that the interest of ASD children is quite large in the use of animation-based learning media.

Keywords: *Autism spectrum disorder (ASD), Animated-tutor, Language comprehension.*

1. INTRODUCTION

Autism Spectrum Disorders (ASD) is a disorder experienced by a child with various forms of impaired social interaction, communication, and cognitive abilities. Children with ASD have repetitive characteristics of behavior, limited interests and cognitive abilities that do not develop properly [1]. In general, children have attention disorders, the ability to remember and process information, it is difficult to shift attention to visual and auditory stimuli as well as difficulties to manage relationships and social interactions as well as limited understanding of feelings conveyed by [2]. There are about 25% of autistic children with low functional abilities have intellectual limitations and limited ability to learn, while children on a different spectrum who have higher functional abilities can improve their intellectual and learning abilities [3].

Determining and providing effective interventions and strategies to support children is a critical issue that is mostly carried out by researchers, educators, and practitioners [3]. Professionally designed instructional interventions, tailored to the child's characteristics, can help children overcome barriers to adapting and interacting socially, improve skills and be able to work accordingly independently. The use of computer-assisted media is an alternative that can efficiently be used to design and implement ability interventions and treatment strategies that aim to improve the quality of life of children [4].

Digital technology has developed tremendously in the last decade has attracted the attention of educators and researchers to use information and communication technology for education and intervention of people with autism. An independent review of the analysis of the use of CAI shows that this technology can reduce behavioral problems, increase responsiveness and communication, and increase individual progress of ASD children in social interaction and daily life [5][6][7].

Computers are widely used in education as a new teaching method for children with autism. More and

Calvert [8] conducted a study to see the effectiveness of computer application programs for teaching vocabulary. Children were able to learn more vocabulary with the help of a computer (74%) than under the direct guidance of a teacher without the help of a computer (41%). Children are also more interested and frequent to learn with computers than with teachers (75%) compared to (65%) because of the autistic children's interest in using gadgets, there is a significant correlation between attention during the intervention and reinforcement and accuracy for remembering vocabulary.

Web technologies and animation multimedia provide capabilities as teaching and development tools for children because it's more focused, easy to manage and predictable and match the preferences of ASD children as visual stimuli. This tool provides an interactive, multimodal, and structured space with clear boundaries and safe restrictions on errors during the learning process. In addition to multimedia applications, various digital technologies have been used, such as digital video virtual reality applications, mobile devices [9] and Web-based environments [8]. Interventions with digital technology lead to abilities in the main areas of adaptive function in: (a) understanding and expression of language in communication [10], (b) ability to communicate and recognizing emotions [11], (c) social interaction, (d) daily life and work-related skills [11][12].

This study discusses an intervention using an animated tutor developed using the web, especially HTML5 for children with ASD to improve communication skills. Applications that were developed to be given as an intervention were developed using HTML5 technology which has been advanced at this time. The trial was conducted on 5 (five) children who showed an increase in the children's ability to identify and raise words based on the animated pictures provided.

In this study, an application prototype was used to provide vocabulary learning to children with ASD. The advantage of using the application is that it can be used anywhere, anytime, anywhere. The developed application can be installed on a tablet PC, or smartphone. With its various strengths and weaknesses, this paper will discuss the collection of requirements, the initial version of the application prototype and the evaluation carried out by teaching staff who work in schools with ASD children.

The purpose of this study was to assess the effectiveness of the web-based animated tutor that has been developed for children. The object of this research is five children with ASD in a school for children with disabilities in Pekalongan City. The initial stage in this study was to examine whether the children had the ability to express vocabulary and were then given treatment using an application.

2. METHODS

There are three stages conducted in this study, namely: pretest as an initial test, intervention (training) and testing and posttest as an assessment after being given an intervention within a certain time span. In the initial study it is necessary to address some issues such as whether the teacher is responsible for the learning process (for example, the child has received training in communication skills with other methods or outside the training program being carried out), whether the child can accept vocabulary based on the media. Animations are presented and the child can generalize new vocabulary based on the media provided and whether the child transform what has been learned into the external environment when assessed by the instructor.

The next experimental design is based on a single multi-subject basic design by continuously testing some vocabulary and other vocabulary is tested and trained on children using the application. Teachers and therapists are required not to use these words during the intervention and testing process. Things that happened were recorded to see the significant differences between the two conditions that occurred and were the result of the training program with various triggering factors.

3. RESULTS AND DISCUSSION

Based on the evaluation conducted to determine the extent to which the teacher contributed to the acquisition and deviation of vocabulary and how much each child responded subjectively to each given intervention (Figure 1). Data were collected and analyzed in three separate stages from the observation process, namely: the initial session before testing, the training intervention session, and the final session at the posttest after the intervention was given. The average number of vocabularies that have been mastered and known, the average number of vocabularies learned using the application, and the average number of vocabularies that are still mastered after a few days can be seen in Figure 1. Based on the tests that have been conducted. The results showed that they experienced retention of vocabulary ability around 91% after learning vocabulary that could be mastered after a few days.

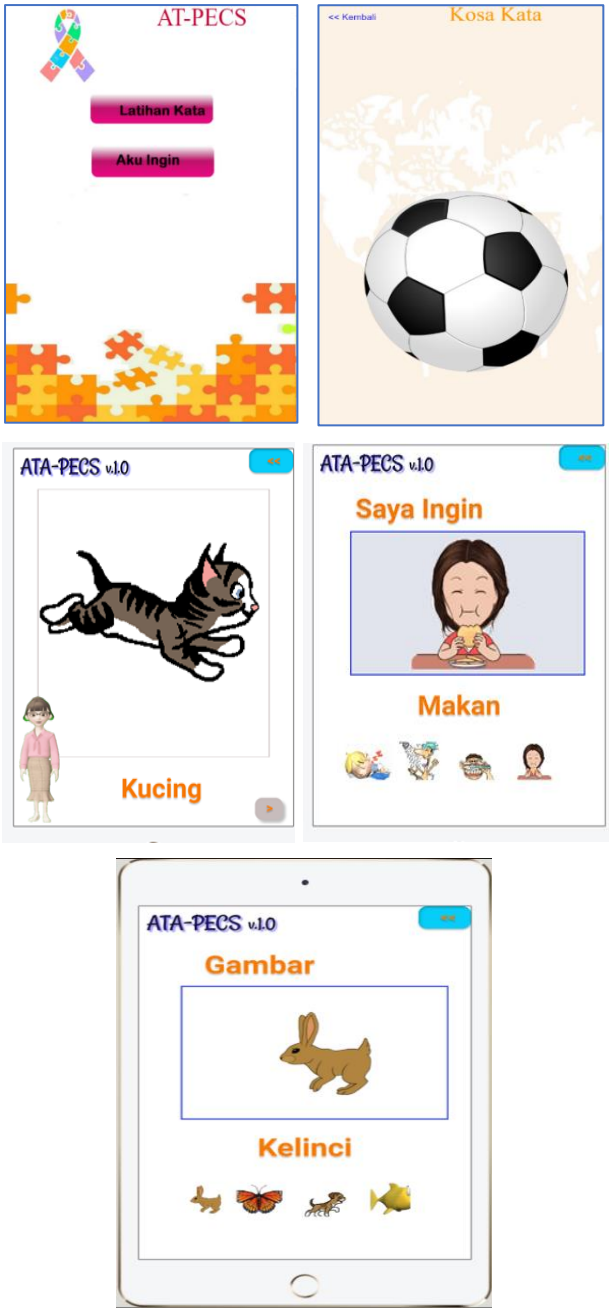

Figure 1 Web-based animated tutor application display.

The curriculum designed so that children go through four stages, namely assessment without feedback, written text intervention, intervention with modified vocabulary, and intervention with modified vocabulary and without text. The child responds verbally during the production intervention and the instructor responds. Children go through three stages of learning until the accuracy is found to reach 100% at the posttest at the final stage of training. Reassessment was conducted after 30 days of the last posttest (Table 1).

Table 1. Description of in-app workouts

Exercise	Description
Pre-test	ATA-PECS asks the child to "click (the word)", and the child is asked to click on the displayed image.
Presentation	One image is highlighted and the app displays: "this is ..." the word according to the image. the application asks the child to click on the requested image and the response from the system shows that it knows which image is requested.
Recognition	ATA-PECS asks the child to click on the picture of the word
Reading	The word will be displayed in a separate area of the image. The child is asked to click on the word that corresponds to the selected image.
Spelling	one of the pictures is highlighted and students are asked to name and the word that corresponds to the picture.
Imitation	One of the images is selected and highlighted the child is asked to repeat the name just spoken by the application.
Elicitation	One of the images is highlighted and the system is prompted to speak the image.
Post-test	the application asks the child to click on the requested word

Before the intervention is given to the child, a series of training sessions are given to introduce the child and instructor to the application. Children will be asked to study in front of the computer guided by the instructor. Children are reinforced with correct behavior and presented with vocabulary learning that has been mastered, besides that monitoring and direction are also carried out during the intervention process and children are expected to be able to learn independently after the learning process.

Table 2 shows the results of each child's individual performance in learning new vocabulary. The preliminary test results show that the average proportion

of 0.44 is correctly identified. The test results at the training stage are pretest and posttest. In each teaching activity, children can identify more vocabulary, it can be seen that significantly the results in the posttest are 0.60 in average with a standard deviation of 0.12 while at the pretest the average is 0.46 with a standard deviation of 0.16; t (5) = 2.99 and p < 0.001. The results of the reassessment after a few days (30 days) after the intervention also showed that the child was able to identify many words significantly, namely an average of 83% with a standard deviation of 0.02 compared to the initial assessment with a true average of 0.14 and a standard deviation of 0.13 with t (5) = 1.89, p<0.0001. This shows that the children were able to support ability in the given vocabulary after several days of training apart from learning that new one (Figure 2).

Table 2. The number of vocabularies mastered at the time of the initial pre-test, intervention and post-test

Child	Known	Learned	Retained	Total	Time on Task
1	70	78	67	215	8,43
2	55	47	36	138	8,1
3	24	55	42	121	7,01
4	43	64	55	162	12,9
5	37	52	45	134	4,21
Total	229	296	245	770	40,65
Mean	45,8	59,2	49	154	8,13
SD	17,54	12,19	12,19	41,92	3,14

Note: Known: the number of items on pretest assessment before training; Learned: the number learned; Retained: the number of retained after 30 days training complete; Total: the total number of items; and Time on Task: the number of hours of training.

Four out of five children seemed happy to work with the given application. Stickers given to appreciate the answers from children by giving happy faces (correct answers) and sad faces (wrong answers) proved to be effective in providing feedback to children. Some children show feelings of frustration when they get more than one sad face and respond positively when they get a happy face. The teacher/instructor then responds by giving praise if the child answers correctly and motivates the child if the answer is wrong.

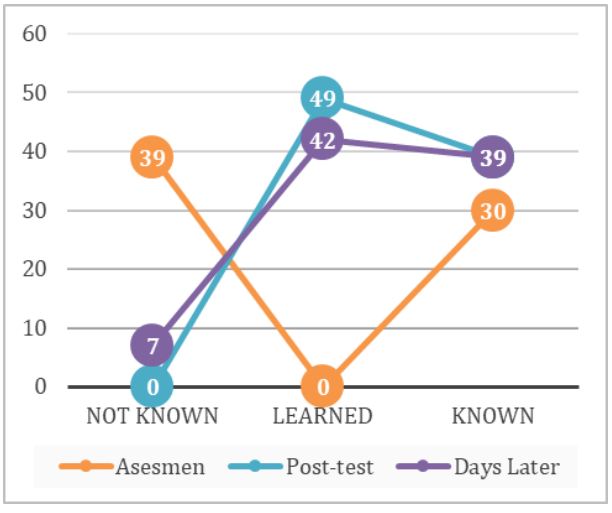

Figure 2 Test results of mastered vocabulary at the time of intervention, post-test and 30 days after treatment.

The purpose of this study was to evaluate the effectiveness of an animated tutor developed using the web to train and develop vocabulary and communication skills as well as mastery and remember vocabulary that has been taught within a certain time (30 days) after mastery. The data collected showed that the child was able to identify significantly more items during the posttest compared to the initial assessment, indicating that the animated tutor application provided was effective in practicing vocabulary. Furthermore, the child was able to remember 83% of the newly learned items at least 30 days after the training was completed.

4. CONCLUSION

This study has evaluated the potential use of a web-based animated tutor application for children with ASD. In the process, it is checked whether children with ASD can learn new vocabulary using the animated tutor application. Assessment of children's performance showed a significant increase in vocabulary mastery where the ability to remember vocabulary displayed through animated images was 83% when reassessed after 30 days of the last intervention process. By using a single-subject multi-basic design, evidence was found that the learning carried out with this animation-based application was able to recognize new images and be able to be transformed outside the application environment.

The advantages of using a computer-assisted web-based animated tutor application include the popularity of computer programs and learning agents which are manifested in the availability of application programs. Instructions that can be available to a child with ASD at any time, 24 hours a day, 365 days a year. Instructions that can occur in the learning environment according to the needs of the child, it was found that students feel

happy using the application because the application offers extraordinary patience, is not angry, is not tired or bored and becomes an eternal learning medium.

AUTHORS' CONTRIBUTIONS

Taryadi: conceptualization, method and drafting manuscript. Sattriedi W. Binabar: Review and editing of manuscript; and Era Yunianto: data curation, data visualization and editing.

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