

Literature Study: Visual Support Design as Assistive Technology for Children with Autism Spectrum Disorder

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Abstract: Providing interventions for children with autism requires various methods and learning media. Visual Support has long been implemented to help train communication skills in children with autism. Recently, many applications have developed as assistive technology to help children with autism in the learning environment. This study aims to elaborate on the visual design integrated into application-based assistive technology for children with autism. The method used in this research is a Systematic Literature Review. Based on the data tracing results, several references have been collected that specifically discuss the design of visual Support. From the data analysis, it can be concluded that visual Support is important to be integrated into digital applications to help children with ASD to carry out daily activities in various environmental settings. The development of visual support design must refer to the prerequisite rules to support the suitability of their characteristics and needs.

Keywords: Visual Support; Assistive Technology; Children with Autism

INTRODUCTION

Children with Autism Spectrum Disorder (ASD) have complex problems, generally referred to as the Autism Trias (American Psychiatric Association, 2013). This has a practical impact because they have problems connecting with social circles that support their cognitive development (Williams et al., 2018). This milestone certainly has a very big influence on their ability to carry out social activities. This ability domain is not only motivated by the quality of social communication skills. However, the results of other studies also prove that executive function skills have a contribution. Although it is known that executive function problems not only appear in children with ASD (Demetriou et al., 2018; Irvan, 2019). However, in children with ASD, the most cases are found with a certain level of severity causing them to have difficulty completing social activities (Demetriou et al., 2019). Social activities in the context of everyday life are closely related to the ability to understand various technical sequences to complete tasks at each stage. Generally, social activities consist of a series of small activities combined into what can be categorized as behaviour. For example, taking a bath, the sequence of bathing activities consists of skills to wash the body, clean the body with soap, use towels, and even must be able to put on clothes again.

The complexity of the problem of social activities has long been a topic of discussion to help children with ASD have a better life quality. TEACCH (Treatment and Education of Autistic and Related Communication Handicapped Children) is a method that has been implemented in providing interventions for children with ASD. (Gándara Rossi, 2007). The implementation of TEACCH manages to train children with ASD through a communicative approach (Sanz-Cervera et al., 2018). This principle is motivated by the pattern of communication disorders in children with ASD. The implementation of TEACCH is also considered to significantly help improve the quality of life of children

with ASD through the completion of social activities. This method trains children with ASD by visualizing the sequence of social activities (Mesibov et al., 2005; Jusoh & Abd Majid, 2017). Visual Support is a supporting media to help children with communication disorders (one of which is a child with ASD). The media, in the form of visual images, is arranged in such a way as to explain the sequence of the process of implementing social activities. Visualization of learning media for children with ASD is the most effective strategy in the intervention process (Rao & Gagie, 2006). This fact is generally related to comorbid disorders in children with ASD, one of which is the problem of central coherence. This condition has a close relationship with the autism triad, making children with ASD look like visual learners.

In recent years, visualization of learning for children with ASD has focused more on using various digital technologies. It aims to portray the media as Assistive Technology for children with ASD. An example is Augmented Reality (AR) which has been implemented in learning for children with ASD. A literature study states that the development of AR in games on various platforms has been shown to positively impact improving aspects of social interaction, emotion recognition, attention skills, and practical learning. (Berenguer et al., 2020; Khowaja et al., 2020; Nazaruddin & Efendi, 2018). Other findings also have similar conclusions, where Virtual Reality (VR) is implemented in learning for children with ASD. In several previous studies, AR was implemented to improve social interaction and social communication skills. The study stated that the most significant impact was seen in children with ASD in the low function category (Junaidi et al., 2021). However, different studies also prove that the high function category also gets similar benefits (Moon & Ke, 2021).

The development of digital technology has an impact on the different types of applications and devices that function as instruments. The instrument is the orientation of the media visualization design. However, based on published studies still do not describe specifically the provisions of visual support design that are considered relevant to the condition of children with ASD. This study aims to describe explicitly the design concepts that must be embedded in visual Support. The results of this discussion are expected to be an implementable reference for further research in developing devices as assistive technology for children with ASD.

METHOD

The method used in this study is a literature study with a Systematic Literature Review approach. This stage is attempted to collect various previous studies that review the design of visual Support for children with ASD. The selection of this approach is based on scientific evidence from the results of research that has been carried out by other researchers before. The procedure for this literature study will go through 3 stages: Plan Review, Conduct Review, and Document Review (Brereton et al., 2007).

Plan review, in this phase, the researcher narrows the topic of information to be collected based on the formulation of a specific problem. Next, develop and validate a review protocol that will be applied to determine the literature's limitations. Conduct Review, in the second phase, the literature study will produce specific data that goes through 5 stages of identification and review. First, identify the literature relevant to the topic specified in the previous stage. It is second, selecting literature content through abstracts and introductions. Third, filter the quality of the studies in each collected literature. Fourth, extracting data based on research needs. Fifth, carry out data synthesis to determine and conclude the study results. Document Review, The last step in this phase is to compile a review report and validate the review report that has been prepared. Article

searches are carried out through searches using relevant keywords, including visual Support (2879 results) and visual support design for autism (2431 results). Based on the search results of these keywords, the researcher attempts to refine the titles in detail to ensure the high relevance of the data collected. In this process, 28 articles were produced that have relevance to the previously determined scope limits. However, the screening process was continued with re-sorting through abstract analysis. The re-sorting aims to get content that specifically reviews the design of visual Support for children with autism.

FINDING AND DISCUSSION

Finding(s)

Plan Review

The search for target literature was carried out by browsing online journal pages. In the Plan review stage, the researcher tries to make limitations to narrow the search area and specify the search results. Some of these limitations include 1) Restriction of the search area aims to ensure the harmony of the publication scope. The area chosen for the search is the publication platform, Springer. The main reason for choosing this site is because two journals have scope relevance: the Review Journal of Autism and Developmental Disorders (RJADD) and the Journal of Autism and Developmental Disorders (JADD). 2) Topic limitation aims to narrow the research field with the topics described in this study. The topic accepted in this study is research that discusses the design of visual Support for children with ASD Conduct Review

Through this process, 64.3% of articles that applied various visual support media with a quantitative approach were found. In comparison, 65.7% used a qualitative approach. However, through the abstract review process, few conclusions were found that revealed the design implemented. There are only three articles that explicitly explain the design, namely 1) Interactive visual supports for children with autism (Hayes et al., 2010); 2) Brief Report: Just-in-Time Visual Supports to Children with Autism via the Apple Watch: A Pilot Feasibility Study (O'Brien et al., 2016); 3) Applying Technology to Visually Support Language and Communication in Individuals with Autism Spectrum Disorders (Shane et al., 2012).

Document Review

The last step in this analysis process is a review of the documents selected in the previous stage. These papers have different research characteristics. Two papers try to implement visual Support through different contexts (see table 1). While the next article reviews the technology used. Based on the results of the analysis that has been done, they try to conclude about the need for visual support design that must be developed in the future.

Shane & Albert, 2008

The paradigm of implementing AAC (Augmentative and Alternative Communication) is increasingly considered potential and becomes a relevant strategy to start exploring communication skills in children with ASD. This paper examines the implementation of technology integrated into AAC. The contexts elaborated by this article include topics on 1) The Evolution of Technology Used in AAC Applications for Individuals with ASD, 2) the Application of Technology Within a Visual Communication Approach for Learners with ASD, 3) Using Technology to Facilitate Effortless Everyday Communicative Exchanges; 4) Using Technology to Improve Language Instruction; 5) Using Technology to Enable Video Modeling. Based on the results of the analysis of the study, the research team stated

that visual Support has a potential role in helping children with ASD build communication skills. However, the development of visual support media needs to adhere to the basic concepts of ASD characteristics. First, pictorial media must be able to visualize in the form of symbols various topics that exist in everyday life, both in the home, school, and community environment. Visual media must be able to facilitate understanding and expression. Third, it must be able to describe multiple contexts, and be communicative in nature in order to make it easier for children with ASD to implement in daily activities.

Table 1. Paper Scoupe Identity

Author, Years	Method	Subject (n)	Media/Technology
Hayes et al., 2010	Mixed Method	n: 21 neuroscientist, special educator, assistive technology specialist, private therapist	Visual Support
O'Brien et al., 2016	Experiment	n: 5 (M: 2/F: 3) Age: 6-7 years	JIT (Just-in-Time)
Shane & Albert, 2008	Qualitative	-	AAC (Augmentative and Alternative Communication)

O'Brien et al., 2016

This study seeks to implement visual Support through the Apple Watch with the JIT (Just-in-Time) method. Implementation of visual sports as an effort to try out the use of Apple Watch as an assistive technology for children with ASD. Researchers assume that the successful use of this device allows it to be used as a guide for children in carrying out daily activities. Apple Watch can help display visual Support for the management of activities to be carried out. Based on the experimental results show that this device was successfully implemented on five samples. However, to ensure its effectiveness, it is necessary to conduct large-scale trials.

Hayes et al., 2010

The use of technology continues to develop over time and allows learning to be increasingly oriented to the use of application-based multimedia. These changes are the background that there needs to be a design suitability test and system support in utilizing it. Researchers are trying to offer three types of assistive technology that are used as visual Support for children with ASD, namely Mocotos, vSked, and SenseCam. This study uses a mixed method involving neuroscientists, special educators, assistive technology specialists, and private therapists. The respondents tested the application of the three assistive technologies, then gave a review of their use. Based on the results of the data analysis, it can be concluded that there are important aspects to consider in implementing visual Support in digital form for children with ASD. These aspects can be used as standard requirements as a procedure in developing and implementing visual Support, including 1) Flexibility, visual Support must be adapted to the abilities and characteristics of children in dealing with schedule changes; 2) Visual Support System, the need for visual Support for children with ASD is not only in the school environment but also in the wider environment. Therefore, it requires a harmonious understanding between various parties such as teachers, caregivers, and families; 3) Family Support, the implementation of visual Support will

have a positive impact if the family environment plays an active role and consistently builds collaboration with other parties to monitor and formulate support needs for children.

Discussion(s)

Children with ASD have several complex developmental disorders, causing them to face various challenges in life (American Psychiatric Association, 2013). Trias Autism has a continuous pattern that influences each other. This generally makes children with ASD have difficulty doing social activities (Schultz, 2005). Impaired communication development is the main domain that causes the input of knowledge to be inhibited, and this condition is responsible for cognitive development. The complexity of these problems is a strong reason that children with ASD require intensive intervention. More than that, they need a good support system from various parties. Of course, the support system is not only a form of learning Support but also various infrastructure facilities. The characteristics of children with ASD are unique. Their characteristics are in stark contrast to other categories of disabilities, despite their similarity in communication. Therefore, communication disorders in children with ASD do not only require speech therapy interventions in general. However, they also need visual Support to make it easier to understand the sequence of daily activities.

Fulfillment of visual support needs is very important for children with ASD. Generally, children with ASD not only have the Autism Trias but also have comorbid disorders. Executive Function and Central Coherence contributed greatly to their delay in understanding schedule sequences and interpreting information comprehensively (Demetriou et al., 2019; Happé, 1997; Klin & Jones, 2006; Cahyadi et al, 2022). This condition is a meeting point that children with ASD need tools to understand simple and clear sequences of activities. Visual Support is the answer to these needs. Visual Support has long been developed to help them understand the sequence of activities. In fact, the TEACCH method was developed with a learning concept that integrates visual Support (Gándara Rossi, 2007; Virues-Ortega et al., 2013). However, the fulfillment of visual Support through intervention programs at school and at home is not enough to help them to be more independent. Because, in fact, children with ASD also have a need to access various public facilities that do not have visual Support. Of course, this is a new challenge for them.

The development of digital-based technology has greatly influenced learning media and assistive devices for people with disabilities, generally referred to as assistive technology. The same applies to the development of assistive technology for children with ASD. There have been many technological aids integrated into their learning. Augmented Reality (AR) has been proven to bring satisfactory results to help children with ASD understand various information about various things in the surrounding environment (Berenguer et al., 2020; Khowaja et al., 2020; Liu et al., 2017). Virtual Reality (VR) is also stated to have a significant impact on the learning context of communication and social interaction (Junaidi et al., 2021; Lorenzo et al., 2019; Moon & Ke, 2021). However, these various features have been scientifically proven to have a positive effect. However, the need for assistive technology is not only limited to the learning process. Therefore, application development and other tools are also needed to assist them in completing their daily tasks.

Based on previous reviews, Hayes et al. (2010) state that the development of visual Support must ensure the compatibility of concepts between environments. This means that in developing visual support designs, relevant parties must be involved in building content agreements and the linearity of the concept of daily activities. This prerequisite is

important to support the consistency of information received by children with ASD who generally have receptive language problems. Furthermore, the research also proves that there is a need for a good support system between teachers, therapists, families, and caregivers (Wei et al, 2017). This Support is very important to ensure that visual Support can be implemented comprehensively and in harmony. The prerequisite concept, in line with the idea from Shane et al. (2012), that the development of visual Support must be able to visualize in the form of symbols various topics that exist in everyday life can facilitate understanding and expression, and can also describe multiple contexts, are communicative. While O'Brien et al. (2016) strengthen their claim that visual design support in digital form can also be integrated into everyday devices (e.g., Apple Watch or Gadget). Digital design allows them to understand the sequence of activities even at a smaller size. However, the image design must represent symbols that are simple, clear, and appropriate to the context.

CONCLUSION

The results of the review have described that children with ASD have comorbid disorders that result in them requiring visual Support. Visual Support would be better if integrated into digital applications as an assistive technology to help them complete daily tasks and activities in various environments. However, because of their characteristics, digital-based visual Support must be developed by referring to the rules to suit their needs. The fulfillment of these requirements must also be followed by the establishment of a support system that involves various parties who are responsible for providing interventions for children with ASD. The results of this literature review are expected to be a reference for the next project in developing digital application-based visual Support as an assistive technology for children with ASD.

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