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The Effectiveness of AVAZ AAC Media in Improving the Expressive Language Skills of Children with Down Syndrome in Surakarta City

Tomas Kurnia Adi*, Dian Atnantomi Wiliyanto, Alfiani Vivi Sutanto

Speech Therapy Study Program, Department of Speech Therapy, Poltekkes Kemenkes Surakarta, Surakarta, Indonesia

*Email: tomaskurniaadi03@gmail.com

Abstract: *Down Syndrome causes intellectual disabilities and language delays, especially expressive language. Children with Down Syndrome require concrete and easy-to-understand learning media. Augmentative and Alternative Communication (AAC), specifically AVAZ AAC. This media has features that can offer effective support. This study aims to analyze the effectiveness of AVAZ AAC in improving the expressive language skills of children with Down Syndrome in Surakarta. This research is a quantitative descriptive study with a quasi-experimental design using a one-group pre-test–post-test approach on 10 children with Down Syndrome who were selected purposively. The intervention consisted of 6 sessions. Expressive language skills were measured using the NSST. Data were analyzed using a Paired t-test and Cohen's d effect size. The average score increased from 6 to 16.3, with a change in category from entirely low to mostly moderate. The Paired T-Test produced p = 0.001, and effectiveness was declared strong with an effect size of Cohen's d = 1.43, indicating a significant influence of AVAZ AAC media. The use of AVAZ AAC media has been proven effective in improving the expressive language skills of children with Down Syndrome, as evidenced by changes in score categories, a p-value of 0.001, and a large effect size (d = 1.43). This media is recommended for continued use by parents, teachers, schools, and therapists, and supported by ongoing research with a larger sample size and extended duration.*

Keywords: Augmentative and Alternative Communication; AVAZ AAC; Down Syndrome; Expressive Language

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1. INTRODUCTION

Communication problems for children with special needs, especially those with Down syndrome, can cause difficulties for others to understand what they are saying. Based on the 2018 Basic Health Research (Riskesdas), the incidence of Down syndrome tends to increase. In 2018, the prevalence of congenital disabilities in children aged 24–59 months was recorded at 0.41 percent, and Down syndrome was experienced by 0.21 percent of that age group (Indahri, 2023). These figures indicate an increase compared to the 2013 Riskesdas data, which recorded a prevalence of 0.13 percent, and the 2010 Riskesdas data, which was at 0.12 percent (Health Research and Development Agency, 2013). Data

from the Medical Rehabilitation Installation of Diponegoro National Hospital, Semarang, from January to February 2024 showed that out of 67 patients (61.19%), two patients (2.98%) diagnosed with Down Syndrome experienced impairments in both receptive and expressive language (Janata et al., 2025). Ideal conditions indicate that children with Down Syndrome require communication support through high-tech AAC media to improve expressive language skills (Costanzo et al., 2023). Media use for children with Down Syndrome generally still tends to be conventional or low-tech. The use of low-tech technology is in the form of symbol-based communication boards or communication books (Fadiah & Trustisari, 2024). This gap prevents children's expressive language development from reaching its maximum potential (Mailinda et al., 2022). This study fills the gap in studies regarding the use of AVAZ AAC media in children with Down Syndrome, especially in the context of improving expressive language skills. To date, similar research remains limited, particularly in the population of children with Down syndrome in Indonesia. Although several AAC interventions have been studied internationally, research examining the effectiveness of high-technology AAC applications such as AVAZ in Indonesian educational settings remains limited. Most AAC interventions implemented in Indonesia still rely on low-technology tools such as communication boards or picture cards, which provide limited opportunities for dynamic vocabulary development and voice output. In contrast, AVAZ offers integrated speech-generating features, customizable vocabulary folders, and symbol-supported language construction that may better facilitate expressive language development in children with Down syndrome (Holyfield et al., 2023; Sreekumar et al., 2020).

Three previous studies have demonstrated that Augmentative and Alternative Communication (AAC) plays a crucial role in supporting communication in individuals with Down syndrome. Sreekumar et al. (2020) found that transitioning from books to the AVAZ AAC app on an iPad improved the communication skills of children with complex communication needs. Holyfield et al. (2023) demonstrated that the decoding feature in AAC technology effectively improved single-word reading skills in individuals with Down syndrome, although it did not replace direct instruction. Meanwhile, Thaís et al. (2018) concluded through a systematic review that various AAC devices have been shown to improve communication, social interaction, and independence in children with Down syndrome. While all of these studies share similarities with this study, differences include the research objectives, study design, focus of the AAC media, and sample characteristics.

Down syndrome is a congenital disorder caused by chromosomal abnormalities present at birth and characterized by moderate to severe intellectual disability resulting from abnormal fetal development (Amanullah, 2022). Children with Down syndrome exhibit better receptive language skills than expressive ones, accompanied by limitations in phonology, syntax, and verbal working memory (Mailinda et al., 2022). In this study, the NSST instrument focuses primarily on syntactic expressive language abilities, including sentence construction, grammatical structure, and the ability to respond to structured verbal prompts. Syntax is an important component of expressive language development because it reflects a child's ability to organize words into meaningful sentences during communication. Previous studies indicate that children with Down syndrome typically experience significant delays in expressive language compared with receptive language, with expressive language development often lagging two to three years behind chronological age, particularly in vocabulary production and syntactic construction (Sudrajad & Purnaningrum, 2024). In addition to having a weaker expressive vocabulary than a receptive vocabulary, children with Down syndrome often experience delays in pronouncing their first words and sentences, as well as a limited vocabulary and less varied word usage (Næss et al., 2021). In Indonesian educational settings, teachers in special schools frequently report similar patterns in which children with Down syndrome demonstrate difficulty expressing needs, forming sentences, and initiating communication during classroom interactions. Children with Down syndrome also frequently experience oral-motor difficulties. The anatomical structure of Down Syndrome is evident in the small oral cavity, a relatively large tongue that tends to protrude, a high-arched, narrow palate, and hypersensitivity or hyposensitivity in area around the mouth (Haya & Fitri, 2024).

To address these communication challenges, children with Down syndrome require concrete learning media that align with their visual learning characteristics (Solehah et al., 2025). One effective approach is the use of Augmentative and Alternative Communication (AAC), which includes the utilization of high-tech applications (Costanzo et al., 2023). AVAZ AAC is a symbol-based communication application with a speech-generating system, proven to help children with language disorders and Autism Spectrum Disorder (ASD) (Sreekumar et al., 2020). High-technology AAC applications such as AVAZ can help bypass these speech production barriers by allowing children to communicate through visual symbols and speech-generating output while still supporting language development (Sreekumar et al., 2020). The intervention in this study was conducted over six therapy sessions to examine the preliminary effectiveness of the AVAZ AAC application in improving expressive language abilities. Previous AAC research indicates that there is no fixed clinical standard regarding the exact number of intervention sessions, as intervention intensity varies depending on research objectives and participant characteristics. Systematic reviews have shown that AAC intervention studies may involve as few as three sessions and up to more than thirty sessions, with session durations ranging from several minutes to over an hour (Moraleda-Sepúlveda et al., 2022). Therefore, a six-session intervention was considered sufficient for evaluating the initial responsiveness of participants to the AAC-based communication intervention. The use of AVAZ AAC in this study also aligns with the Total Communication approach, which suggests that alternatives to standard communication forms, such as signs, symbols, and electronically generated speech, can supplement or replace speech. Adding modes of communication to speech has the potential to strengthen the message. Therefore, this study is necessary to fill the existing research gap, particularly regarding the effectiveness of AVAZ AAC media in enhancing the expressive language skills of children with Down syndrome in Surakarta City.

2. METHOD

This study employed a quantitative descriptive approach, with a quasi-experimental research design and a one-group pre-test and post-test method. Quasi-experimental research is research used to test causal relationships between variables without completely randomizing the research subjects (Anantasia, 2025).

Pretest	Intervention	Posttest
Q1	X1	Q2

Information

Q1: Pretest: expressive language assessment using the NSST before intervention using AVAZ AAC media
X1: Intervention using AVAZ AAC media.
Q2: Posttest: expressive language assessment using the NSST after intervention using AVAZ AAC media.

Figure 1 shows the one-group pretest-posttest research design.

Figure 1. One-group pretest-posttest design research design

This research was conducted at Surakarta State Special Needs School and Panca Bakti Mulia Special Needs School in Surakarta on children with Down Syndrome who have limitations in expressive language. A sample of 10 children with Down Syndrome was determined using purposive sampling. The study employed a purposive sampling technique based on several specific inclusion criteria. The participants were children medically diagnosed with Down syndrome currently enrolled in the fifth grade of special education primary schools. Key requirements included demonstrating limited expressive

language abilities while maintaining the capacity to engage with tablet-based learning media under teacher supervision. To minimize variability in educational exposure, all participants were selected from similar learning environments within special schools (1). Children with Down Syndrome have difficulty expressing their needs and desires verbally in everyday interactions. This condition aligns with previous findings that children with Down Syndrome demonstrate better receptive language skills than expressive ones, accompanied by limitations in phonology, syntax, and verbal working memory (Mailinda et al., 2022). Given the gap between expected and actual abilities, adaptive learning media that support the visual characteristics of children with Down Syndrome are needed.

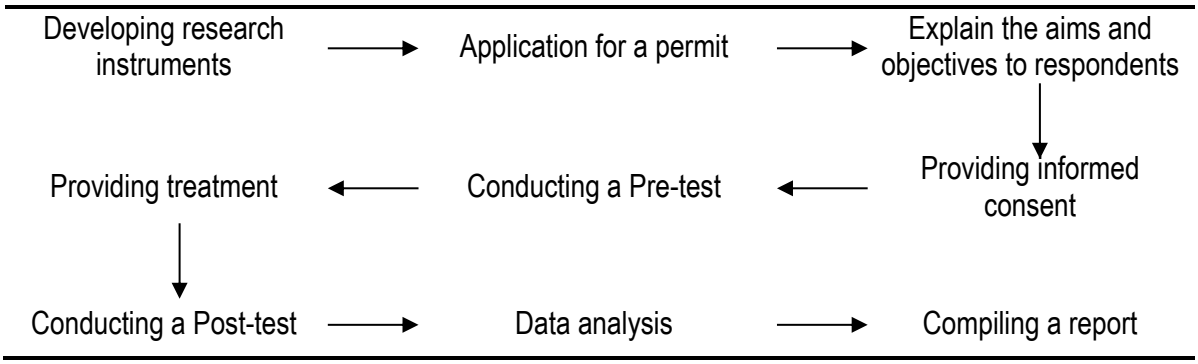


Figure 2. Data collection procedures

Data collection in this study employed the Northwestern Syntax Screening Test (NSST), ensuring standardized measurement of expressive language performance among participants. This test aims to assess both receptive and expressive syntactic comprehension in children (Lee, 1970). The data collection procedure involved first developing the NSST instrument, which had been reviewed through a literature review to ensure its feasibility. After obtaining permission from the school through formal methods, the researcher explained the research objectives to the school, homeroom teachers, and parents, and then distributed informed consent forms as a form of official approval. Next, a pretest and posttest were administered to obtain data on expressive language skills before and after the intervention. The pre-test and post-test assessments were conducted in a quiet classroom environment within the participating special schools to ensure that participants felt comfortable and familiar with the setting. Environmental consistency is important in communication assessments because children with developmental disabilities may show different responses in unfamiliar environments (Shipley & McAfee, 2021).The final stage involved data processing using SPSS and compiling a research report systematically, adhering to scientific principles.

The intervention using the AVAZ AAC application was conducted over six sessions to support the development of expressive language abilities in children with Down syndrome. Each session lasted approximately 30–40 minutes and was implemented in a structured learning environment at the participants' school using the Total Communication approach, which integrates speech, gestures, facial expressions, and augmentative and alternative communication (AAC) systems. In the first session, the researcher prepared the device and conducted the initial setup of the AVAZ AAC application, including creating a user profile, selecting language settings, and adjusting the visual display of symbols according to the child's communication needs. The second and third sessions focused on introducing the application interface and training participants to recognize and select picture symbols representing familiar objects or actions. The fourth and fifth sessions involved structured practice in constructing simple responses using symbols based on materials adapted from the Northwestern Syntax Screening Test (NSST), accompanied by repeated practice and positive reinforcement. The final session was conducted to evaluate participants' expressive language abilities using the NSST as a post-test to measure improvements after the intervention.

After administering the pretest, intervention, and posttest, the data were analyzed using the Statistical Package for the Social Sciences (SPSS) software. Univariate analysis was applied to describe the characteristics of each research variable descriptively. Bivariate analysis was then used to assess differences in expressive language skills before and after the intervention. The normality test was conducted using the Shapiro-Wilk because the sample size was <50. After meeting the normality assumption, the effectiveness of the treatment was tested using a paired t-test to compare pre- and post-intervention conditions. The results of the statistical test were then interpreted in terms of the significance value (p-value) and the magnitude of the treatment effect using Cohen's d. The conclusion was drawn based on the consistency between the results of the descriptive, inferential, and effect size analyses, thus obtaining a comprehensive understanding of the effectiveness of AVAZ AAC media in improving the expressive language skills of children with Down Syndrome in Surakarta City.

3. RESULT AND DISCUSSION

AVAZ AAC is a speech-generating application for the iPad that utilizes high-quality speech synthesis, along with image symbols or text, to help users construct desired messages and develop their language skills (Sreekumar et al., 2020). This indicates that AVAZ AAC falls into the category of high-tech augmentative and alternative media because it integrates digital features, synthetic speech, and interactive visuals to optimally support user communication. The device is relatively inexpensive and portable, allowing clinicians to select the application most suitable for the client's current age and evolving needs (Shipley & McAfee, 2021). AVAZ AAC allows individuals to express themselves by creating their own messages and using synthetic speech to convey them (Sreekumar et al., 2020). The device is customizable, allowing users to include personally relevant content, add photos and personal messages, and increase in complexity as the user progresses (Shipley & McAfee, 2021).

This study aims to determine the effectiveness of AVAZ AAC media in improving the expressive language skills of individuals with Down Syndrome in the city of Surakarta. This study was conducted in two locations, namely Surakarta State Special Needs School and Panca Bakti Mulia Special Needs School in Surakarta. The sample used in this study was 10 children with Down Syndrome. This study utilized the Northwestern Syntax Screening Test (NSST) as both a pre-test and post-test assessment instrument. This study used AVAZ AAC as an intervention medium. Data processing in this study used the Paired Sample T-Test.

Table 1. Frequency distribution of expressive language before treatment

Pre-Test Value	Frequency	Percentage(%)
Low	10	100%
Medium	0	0%
High	0	0%
Total	10	100%

Based on Table 1, the expressive language abilities of children with Down Syndrome before treatment showed a homogeneous distribution in the low category. All 10 respondents (100%) were found to be in the low category of expressive language ability, with no participants reaching the medium or high categories, indicating uniformly limited initial performance. This finding illustrates that the initial expressive language abilities of all study participants were still very limited and far below the expected developmental category, so appropriate intervention is needed to improve these abilities. This study consisted of six treatment sessions, during which questions related to the NSST instrument were asked at each session. The following is an overview of the treatment:

Table 2. Frequency distribution of treatment with AVAZ AAC

Respondents	Baseline	Session					
		1	2	3	4	5	6
1	5	4	6	7	6	9	11
2	2	2	1	4	6	5	3
3	5	6	6	5	10	13	13
4	7	13	14	9	14	22	27
5	9	8	12	15	18	21	25
6	7	7	7	6	8	10	13
7	2	3	4	3	3	4	4
8	8	7	10	13	13	20	25
9	6	9	10	15	14	16	17
10	9	10	11	13	13	15	16
Mean	6.0	6.9	8.1	9.0	10.5	13.5	15.4
Category	Low	Low	Low	Low	Low	Medium	Medium

Table 2 presents the distribution of expressive language skills in children with Down syndrome following treatment with AVAZ AAC media over six sessions. At baseline, the average expressive language skill score was 6, indicating a low score. After treatment, the score gradually increased with each session. The average score increased to 6.9 in the first session, then again to 8.1 in the second session, then to 9 in the third session, then to 10.5 in the fourth session, then to 13.5 in the fifth session, and finally to 15.4 in the sixth session. This pattern of improvement exhibits a stable and progressive trend throughout the intervention period. Changes in ability categories showed significant improvement. All respondents were in the low category at baseline; however, by the fifth and sixth sessions, most had progressed to the moderate category. These data indicate an improvement during treatment with AVAZ AAC media, as children with Down syndrome prefer concrete learning media that align with their visual learning characteristics (Solehah et al., 2025). This study then conducted a posttest after receiving treatment, with the results as shown in the following table:

Table 3. Frequency distribution of expressive language after treatment

Post-Test Value	Frequency	Percentage(%)
Low	3	30.0%
Medium	4	40.0%
High	3	30.0%
Total	10	100%

Table 3 illustrates that the frequency distribution of expressive language ability is categorized into three levels: low, medium, and high. Specifically, the sample size with low scores was 3 respondents (30.0%), medium scores were 4 respondents (40.0%), and high scores were 3 respondents (30%).

Table 4. Distribution of pre-test and post-test means

Results	N	Minimum	Maximum	Mean	Std. Deviation
Pre-Test	10	2	9	6	2.539
Post-Test	10	4	29	16.3	9.031

Table 4 shows that the expressive language ability of children with Down Syndrome using AVAZ AAC media, as assessed by 10 respondents at special schools in the State Surakarta and Panca Bakti Mulia, yielded an average score of 6 in the pre-test and 16.3 in the post-test. From the comparison, it is known that there is an average increase of 10.3 between the pre-test and post-test scores. This indicates that after using AVAZ AAC media, the expressive language abilities of children with Down syndrome have improved. This significant increase illustrates that AVAZ AAC media is effective in helping children with Down Syndrome improve their expressive language, which plays an important role in their language and communication development.

Figure 3 shows the distribution of the pre-test and post-test scores.

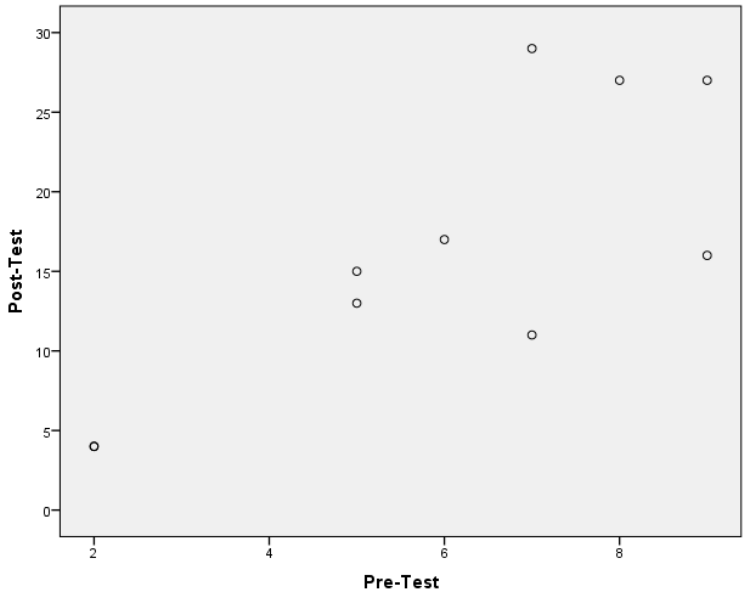


Figure 3. Distribution of pre-test and post-test

The scatter plot analysis showed a positive correlation between the pre-test and post-test scores. However, a considerable variability in participants' performance was observed in the final scores. Although all participants demonstrated improvement, the range of post-test scores (approximately 4 to 29) indicates that the impact of the intervention varied individually. For example, among participants with the same pre-test score (score of 9), there was a notable difference in post-test outcomes, with scores ranging from 16 to 27. These differences may be influenced by individual factors such as cognitive ability, familiarity with technology, baseline language level, and level of attention during the intervention sessions. (2).

Table 5. Results of pre-test and post-test normality tests

	Shapiro-Wilk		
	Statistic	*df*	*Sig.*
Pre-Test	0.906	10	0.252
Post-Test	0.912	10	0.293

Table 5 shows the normality test for the pre-treatment and post-treatment groups. The Shapiro-Wilk test was used for normality because the study involved 10 respondents, meaning the sample size was <50. The Shapiro-Wilk test yielded a pre-test value of 0.252 and a post-test value of 0.293, indicating a normal distribution.

A paired sample t-test was then performed because the data were normally distributed. The paired sample t-test is used to compare or determine the differences between the average values of two paired data variables. The paired sample t-test is as follows:

Table 6. Results of bivariate analysis of pre-test and post-test

	Mean	Std. Deviation	*p*-value
Pre Test-Post Test	-10.300	7.196	0.001

The statistical analysis results from table 6 obtained a p-value (Sig. 2-tailed) of 0.001 which is below the significance limit of 0.05. These results indicate that there is a difference between the pre-test and post-test scores of the expressive language abilities of Down Syndrome children after being treated with AVAZ AAC media. To determine the extent of the influence of AVAZ AAC media, the effect size can be calculated using the formula and Cohen's d criteria as follows:

Table 7 presents the effect size criteria.

Table 7. Effect size criteria

Interpretation	*Effect Size*
Weak Effect	0 - 0.20
Modest Effect	0.21 - 0.50
Moderate Effect	0.51 – 1.00
Strong Effect	> 1.00

Based on the calculation results, the value of d = 1.43 was obtained. Referring to the effect size criteria in Table 7, this value falls into the strong category. This finding indicates that AVAZ AAC is effective in improving the expressive language skills of children with Down syndrome. This is supported by research that suggests that high-tech AAC can improve message composition skills in children with language limitations (Sreekumar et al., 2020).

After conducting the study, the researchers obtained results on expressive language ability, as outlined in Table 1, as well as the frequency distribution of expressive language before treatment. The results of the expressive language ability measurement indicate that all 10 children (100%) scored in the low score category. It is known that children with Down syndrome have a weaker expressive vocabulary than their receptive vocabulary (Næss et al., 2021). This indicates that limited language production remains a major problem for children with Down syndrome. This situation highlights the importance of media that supports the expressive language skills of children with Down syndrome. One such medium is AVAZ AAC.

Researchers provided treatment using AVAZ AAC. This medium can help students express themselves by creating their own messages and using synthetic voice to convey those messages (Sreekumar et al., 2020). Several features of the AVAZ AAC application may have contributed to the observed improvements. The voice output feature allows children to hear the spoken form of selected symbols, which supports auditory reinforcement and word learning. The picture symbol system helps children associate visual representations with communicative meanings, making it easier for them to express needs and ideas. Additionally, the organized folder structure enables users to navigate symbols more efficiently and construct simple expressions or short phrases. (4). The researchers provided treatment over six sessions using AVAZ AAC, as outlined in Table 2, a frequency distribution of AVAZ AAC treatment sessions. Researchers conducted evaluations at the end of each session and found an

increase in the average score across sessions. The score increased gradually, from 6.9 in the first session to 8.1 in the second, then to 9 in the third, then to 10.5 in the fourth, then to 13.5 in the fifth, and finally to 15.4 in the sixth. This change in ability category indicates a positive response to the use of AVAZ AAC, with some respondents entering the "moderate" category in the fifth and sixth sessions.

The results of the Paired Sample T-Test in Table 6 show a p-value of 0.001, meaning $p < 0.05$, thus accepting Ha and rejecting H0. A difference was found between the pre-test and post-test scores of children's expressive language skills after treatment using AVAZ AAC. When compared with international studies investigating AAC-based interventions for children with Down syndrome, the findings of this study are consistent with previous research demonstrating improvements in expressive communication after AAC implementation. Research has shown that structured AAC interventions can support the development of expressive grammar and increase the length of utterances produced by children with Down syndrome (Kent-walsh et al., 2025). (3). To determine the magnitude of the AVAZ AAC's influence, an effect size was calculated using Cohen's d formula. The calculation yielded a d value of 1.43. Based on the effect size criteria, this value falls into the strong category (Suparman et al., 2021). This finding indicates that AVAZ AAC is effective in improving the expressive language skills of children with Down syndrome. This finding is supported by research showing that high-tech AAC can improve message composition skills in children with language limitations (Sreekumar et al., 2020). It is important to consider whether the observed improvement was influenced by the novelty of the tablet-based application or reflected genuine communication skill acquisition. While the introduction of a digital device may initially increase engagement and motivation, the repeated practice across multiple sessions and the structured use of communication symbols suggest that the improvement was not solely due to the novelty effect but also reflected early stages of language skill development. (1). An important aspect observed during the intervention was the generalization of communication skills. Some children began to use the words learned through the AVAZ AAC application in other contexts, such as verbal attempts or gestures during interactions with teachers or peers. (5). The intervention demonstrated signs of symbolic growth among several participants. Initially, many children used single-word selections when responding to prompts. However, as the sessions progressed, some participants began combining symbols to form short phrases or simple expressions. (6).

The effectiveness of AVAZ AAC in this study aligns with the theory that high-tech AAC devices can support language development through speech synthesis and easily recognizable symbol representation (Costanzo et al., 2023). The use of visual symbols helps children with Down syndrome construct words more easily. High-tech AAC media such as AVAZ AAC are flexible for use in therapy because they can be tailored to individual needs, including the addition of relevant images or vocabulary (Shipley & McAfee, 2021). This flexibility allows children to practice gradually as they develop. These results are consistent with the language characteristics of children with Down syndrome, whose weak expressive language skills require the support of media that provide visual and auditory language models (Næss et al., 2021).

Several factors contributed to the improvement in expressive language in this study. First, the synthetic voice output provides a speech model for children to imitate (Sreekumar et al., 2020). Second, this media offers considerable flexibility because it can be tailored to the child's needs through the addition of vocabulary, the use of images, and the organization of materials (Shipley & McAfee, 2021). Third, the attractive and easy-to-use visuals engage children with Down syndrome with learning materials (Janata et al., 2025). All of these factors align with the characteristics of children with Down syndrome, who tend to process information more easily through simultaneous visual and auditory approaches.

Practically, the findings of this study suggest that the use of AVAZ AAC media can serve as an alternative intervention for teachers and speech therapists in their efforts to improve the expressive language skills of children with Down syndrome. This media serves as an aid that facilitates the gradual

process of language production according to the child's language developmental abilities. From a theoretical perspective, the research results

4. CONCLUSION AND SUGGESTIONS

Prior to the intervention, all participants demonstrated expressive language skills in the low category (100%). Following the AVAZ AAC intervention, a notable redistribution of abilities was observed, with 30% of participants in the low category, 40% in the moderate category, and 30% in the high category. Paired t-test results confirmed a statistically significant difference between pre-test and post-test scores ($p = 0.001$, $p < 0.05$), and effect size calculation yielded a Cohen's d of 1.43, indicative of a large practical effect. These findings collectively demonstrate that AVAZ AAC is effective in improving the expressive language skills of children with Down syndrome in Surakarta.

On the basis of these findings, several recommendations are proposed. Parents are encouraged to provide consistent home-based stimulation using AVAZ AAC to reinforce symbol recognition and facilitate the expression of needs in everyday contexts. It is further recommended that the AVAZ AAC system incorporate a localised symbol library reflecting Indonesian cultural contexts and daily activities, as culturally relevant content may enhance comprehension and usability for Indonesian children with communication difficulties. Teachers and speech therapists are encouraged to integrate AVAZ AAC into instructional and therapeutic practice, tailoring implementation to each child's individual abilities whilst combining it with conventional methods. Training in AAC implementation should additionally be embedded within the Special Education Teacher (Guru Pembimbing Khusus/GPK) certification curriculum to ensure that educators possess the requisite knowledge and competencies to support students who rely on augmentative and alternative communication systems. Future researchers are advised to expand sample sizes, extend intervention durations, account for additional variables such as cognitive ability and environmental support, and compare AVAZ AAC with alternative technological media to yield more comprehensive and generalisable findings.

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