



## KAAYA: A Wearable AAC Device for Enhancing Daily Communication of Learners with Mild Intellectual Disabilities

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**Abstract:** This study developed and evaluated KAAYA, a low-tech wearable augmentative and alternative communication device to improve functional and expressive communication in a child with mild intellectual disability. A mixed methods design integrated quantitative and qualitative data. One eight-year-old participant with adequate receptive language but limited expressive skills received the intervention. Data sources included structured classroom observations, a receptive and expressive communication rubric, pretest and posttest assessments, and interviews with teachers and parents. The pretest total score was nine, indicating reliance on nonverbal gestures and difficulty expressing basic needs. After three weeks, the posttest rose to twenty-four, 24, and the child used KAAYA buttons to request food, toileting, and play. Session-by-session observations and PND indicated progressive gains during intervention. Qualitative data showed reduced miscommunication, greater independence, and improved social participation at school and home. Results suggest that KAAYA is an effective, practical, and context-appropriate low-tech wearable AAC device for supporting functional communication and social participation in children with mild intellectual disabilities across structured educational settings and daily routines.

**Abstrak:** Penelitian ini mengembangkan dan mengevaluasi KAAYA, perangkat AAC wearable low tech yang dirancang untuk meningkatkan komunikasi fungsional dan ekspresif seorang anak dengan hambatan intelektual ringan. Pendekatan mixed methods mengintegrasikan data kuantitatif dan kualitatif. Satu partisipan berusia delapan tahun memiliki kemampuan bahasa reseptif memadai namun keterbatasan ekspresif. Sumber data meliputi observasi kelas terstruktur, rubrik komunikasi reseptif dan ekspresif, pengukuran pretest dan posttest, serta wawancara dengan guru dan orang tua. Skor pretest total adalah sembilan, menunjukkan dominasi gestur nonverbal dan kesulitan menyampaikan kebutuhan dasar. Setelah tiga minggu implementasi KAAYA skor posttest meningkat menjadi dua puluh empat dan anak menggunakan tombol KAAYA secara konsisten untuk meminta makan, ke toilet, dan bermain. Observasi sesi demi sesi dan PND menunjukkan peningkatan progresif selama intervensi. Data kualitatif melaporkan berkurangnya miskomunikasi, meningkatnya kemandirian, serta perbaikan partisipasi sosial di sekolah dan rumah. Hasil menunjukkan bahwa KAAYA efektif, praktis, dan sesuai konteks untuk mendukung komunikasi fungsional serta partisipasi sosial anak dengan hambatan intelektual ringan dalam lingkungan pendidikan terstruktur di tingkat sekolah khusus dan rutinitas sekolah serta kehidupan sehari-hari.

## A. Introduction

Education plays a fundamental role in improving the quality of human life by enabling individuals to develop their potential and participate meaningfully in society (Turnbull & Turnbull, 2001). In the context of special and inclusive education, improving educational quality is not limited to academic achievement but also includes supporting functional skills that enable learners to engage independently in daily activities. Quality improvement in special education settings requires school-based management approaches that emphasize both instructional effectiveness and functional skill development (Asniyati, 2022). Syah (2025) explains that the teaching and learning process involves dynamic human interactions, requiring instructional designs that accommodate diverse student needs. This principle is particularly important for children with mild intellectual disabilities, who often experience limitations in verbal communication and therefore require appropriate support systems.

In Indonesia, the implementation of inclusive and special education emphasizes the fulfillment of children with disabilities' functional needs, including communication support that promotes independence and social participation (Phytanza et al., 2023; Purbasari et al., 2021). Communication ability is a foundational skill that allows children to express needs, make simple choices, and interact with others in both academic and non-academic contexts. Without adequate communication support, children with intellectual disabilities may face barriers that limit their participation in learning activities and social interactions. Understanding the specific communication needs of children with disabilities in inclusive settings is essential for designing appropriate interventions (Husadani & Wiliyanto, 2023), and comprehensive assessment tools play a crucial role in identifying communication challenges and determining appropriate support strategies (Shipley & McAfee, 2021).

Children with mild intellectual disabilities often have difficulty expressing basic needs, emotions, and intentions in spoken language. Limited functional communication can lead to frustration, dependence on adults, reduced social interaction, and the emergence of maladaptive behaviors. Fitriani et al (2019) state that effective communication skills play a crucial role in enhancing independence, social participation, and overall quality of life for children with communication barriers. Therefore, providing appropriate communication interventions is essential to support their development.

Preliminary observations conducted at SLB X revealed that a child with mild intellectual disability experienced significant challenges in expressing basic needs, such as hunger and the need to use the toilet. The child frequently relied on unclear gestures that were often misunderstood by teachers, resulting in unmet needs and repeated incidents, including urinating in the classroom. These communication barriers not only affected the child's emotional well-being and dignity but also disrupted classroom activities, highlighting the urgent need for communication media that are easily accessible, practical, and usable throughout the school day.

Augmentative and Alternative Communication (AAC) refers to a range of tools and strategies designed to support or replace verbal communication for individuals with communication difficulties (Logan et al., 2017). AAC systems may be unaided, such as gestures and body movements, or aided, including picture-based media, communication boards, and digital applications (Shiple & McAfee, 2021; Aisy et al., 2024). Previous studies have shown that AAC interventions can improve functional communication, independence, and social interaction among children with intellectual and developmental disabilities (Riswari et al., 2022; Rizqita et al., 2022). A systematic review by Logan et al (2017) further demonstrated that aided AAC interventions are particularly effective in supporting children with autism spectrum disorder to produce a broader range of communicative functions beyond simple requesting, including social interaction and commenting.

However, the implementation of AAC in Indonesian special school contexts remains limited and faces several challenges. Many schools rely on static visual media, such as vocabulary cards, which are not always portable or readily available during spontaneous communication. Recent advances in AAC technology have explored wearable solutions that provide continuous access to communication tools. Zhao et al (2023) developed a wearable AAC (wAAC) device demonstrating that portability and constant availability are critical factors for effective AAC implementation. Similarly, Carnett et al (2025) proposed a multi-phase assessment framework for selecting appropriate AAC modalities, emphasizing the importance of matching device characteristics with user needs and contexts. On the other hand, AAC systems based on digital technology—such as the Mi-Says application developed by Rizqita et al (2022) have demonstrated effectiveness but may pose constraints related to device availability, cost, technical maintenance, and sustainability in daily school routines. As a result, children may not consistently access AAC support when they need it most.

This situation reveals a clear research gap. While previous studies have examined digital AAC applications and non-wearable visual media, there is limited research on low-tech wearable AAC devices that are low-cost and specifically designed for use in Indonesian special school (SLB) settings. Existing AAC tools often fail to address the need for continuous accessibility and contextual suitability in the classroom. To respond to this need, this study developed KAAYA (*Komunikasi Alternatif Augmentatif Yaya*), a wearable low-tech AAC device designed to support children with mild intellectual disabilities in expressing their basic needs more independently. KAAYA is designed in a child-friendly form and can be worn throughout the day, enabling children to access communication support whenever needed during learning activities. The device uses simple pictorial symbols representing daily routines such as eating, going to the toilet, and playing so that children can easily recognize and apply them within natural communication contexts at school.

To address this gap, this study developed KAAYA, a wearable low-tech AAC device designed to support children with mild intellectual disabilities in expressing their basic needs independently. KAAYA is designed in a child-friendly form and can be worn throughout the day, ensuring constant accessibility. The device uses simple pictorial

symbols that represent daily activities such as eating, going to the toilet, and playing, making it easy for children to recognize and use within natural communication contexts.

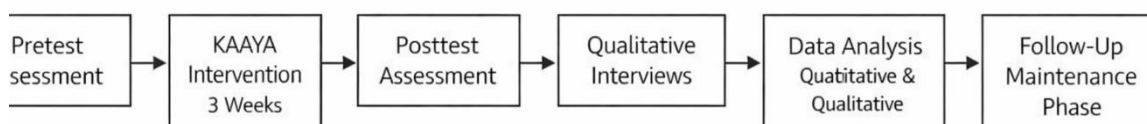
Based on the identified problem and Research gap, this study explicitly addresses three Research questions. First, it examines whether KAAYA use improves a child with mild intellectual disability's functional and expressive communication abilities, particularly in expressing basic daily needs. Second, it explores teachers' and parents' perceptions of KAAYA's usability and social validity as a communication support tool in both school and home contexts. Third, this study investigates whether the observed improvements in communication abilities are maintained during the follow-up or maintenance period, indicating the intervention's sustainability over time.

This study contributes to the field of special education in several ways. Theoretically, it expands the literature on low-tech wearable AAC interventions for children with intellectual disabilities. Methodologically, it employs a single-case mixed-methods design, integrating quantitative communication outcomes with qualitative data on social validity. Practically, this study offers a feasible and contextually appropriate model for implementing wearable AAC media in special school settings, supporting teachers and parents in facilitating children's functional communication.

## B. Method

This study employed a mixed-methods approach with a sequential explanatory design, in which quantitative data collection was conducted first and followed by qualitative data collection to provide contextual explanations for the quantitative findings (Khabibullah et al., 2024). This approach enabled the researcher to examine both measurable changes in communication abilities and the practical use of KAAYA within daily classroom activities.

The participant in this study was an 8-year-old female child diagnosed with mild intellectual disability, selected through purposive sampling based on initial observations indicating expressive communication difficulties. The child demonstrated adequate receptive language abilities, as she understood simple verbal instructions, but experienced significant limitations in expressive communication, particularly in conveying basic needs such as eating and toileting. These limitations affected daily school activities and had previously resulted in toileting accidents due to the child's inability to express urgency. The child also demonstrated very good fine and gross motor skills, allowing independent operation of the AAC device. This study employed a mixed-methods approach with a sequential explanatory design to examine the effectiveness of the KAAYA intervention in improving a child's functional and expressive communication abilities. The overall Research flow is presented in Figure 1.



**Figure 1.** Research Flow of the KAAYA Intervention Study

The figure presents a Research flow diagram illustrating the study's stages. It begins with a pretest to measure baseline communication abilities, followed by a 3-week KAAYA intervention. After the intervention, a posttest assessment is conducted to evaluate changes in communication skills. Qualitative interviews with teachers and parents are then carried out to gather contextual and social validity data. The process continues with quantitative and qualitative data analysis and concludes with a follow-up maintenance phase to examine the sustainability of the intervention effects.

The participant came from a low socioeconomic family background, with the mother working as a housewife and the father employed as an online motorcycle taxi driver. This context informed the development of KAAYA as a low-cost, low-tech AAC solution suitable for daily school use. Inclusion criteria included a diagnosis of mild intellectual disability, functional expressive communication difficulties, adequate motor abilities, and regular school attendance. Children with severe sensory impairments or significant motor limitations were excluded.

The study was conducted at SLB X, located at Jl: Villa Duta No. 2, Ciwaruga, Parongpong District, West Bandung Regency, West Java. SLB X applies a relatively small teacher–student ratio, with eight teachers responsible for six to seven students each. All Research activities were carried out in the participant's regular classroom to ensure ecological validity.

The intervention used KAAYA, a low-tech wearable Augmentative and Alternative Communication (AAC) device designed to support the expression of basic needs during classroom activities. The intervention was implemented over three weeks, with five sessions per week, and integrated into instructional hours between 08.00 and 10.00. The researcher facilitated the intervention.

The intervention protocol was implemented through a series of structured yet flexible steps integrated into daily classroom activities. The process began with the introduction of the KAAYA device, during which each pictorial symbol was explained with simple, consistent verbal labels to support comprehension. This was followed by a familiarization phase that allowed the child to freely explore and operate the device, building comfort and interest. The researcher then modeled the use of KAAYA in naturally occurring classroom situations to demonstrate appropriate communication behaviors. Guided practice was subsequently provided, enabling the child to use KAAYA to express basic needs with support through verbal and gestural prompts when necessary. A least-to-most prompting strategy was applied, starting with natural cues and progressing to verbal, gestural, and minimal physical assistance as required. Over time, prompts were gradually faded to promote independent and spontaneous communication. Natural reinforcement was consistently provided by responding immediately to the child's expressed needs, reinforcing the functional use of KAAYA within meaningful communication contexts.

Data collection involved both quantitative and qualitative techniques. Quantitative data were obtained using a structured receptive–expressive language assessment rubric administered before and after the intervention. Qualitative data were collected through

direct classroom observations, structured interviews with teachers and parents, and anecdotal records documenting the child's communication behaviors during daily routines. A structured observation sheet was used to systematically record communication attempts.

Data analysis was conducted using two approaches. Quantitative data were analyzed using descriptive pretest–posttest analysis to identify changes in communication performance following the intervention. Qualitative data were analyzed using thematic analysis to explore patterns of behavioral change and stakeholder perceptions of KAAYA's usability.

Formal measures of treatment fidelity and interobserver agreement were not implemented in this study. Monitoring of intervention implementation relied on descriptive observation notes recorded by the researcher. Future Research is recommended to include fidelity measures to strengthen methodological rigor.

### C. Result

The communication assessment instrument used in this study was a structured rubric developed to evaluate functional communication behaviors using the KAAYA device. The rubric employed a three-point scale ranging from 1 to 3, where a score of 1 indicated no observable communication behavior, a score of 2 represented communication through gestures or non-verbal behaviors without activating the KAAYA buttons, and a score of 3 reflected appropriate activation of the KAAYA buttons to express functional needs, including eating, toileting, and playing. The rubric was reviewed by special education practitioners to ensure clarity and relevance to classroom communication demands and was applied consistently across the pretest, intervention, and posttest phases.

#### Pretest and Posttest Communication Scores

Quantitative data from the pretest and posttest assessments were used to examine changes in the child's functional and expressive communication abilities following the KAAYA intervention. The pretest and posttest communication scores are presented in Table 1.

**Table 1.** Pretest and Posttest Communication Scores

Communication Indicator	Pretest	Posttest
Requesting eating	2	3
Requesting toileting	1	3
Requesting play	2	3
Initiating interaction	1	2
Total Score	6	11

Table 1 presents a comparison of the child's functional and expressive communication performance before and after the KAAYA intervention across four communication indicators. Prior to the intervention, the child demonstrated limited

functional communication abilities, as reflected in low pretest scores. In the pretest phase, the child obtained a score of 2 for requesting eating and play, indicating that communication was mainly expressed through gestures and nonverbal behaviors, without activating the KAAYA buttons. Requesting toileting had the lowest pretest score of 1, suggesting the absence of clear communication about toileting needs. Similarly, initiating interaction also received a pretest score of 1, indicating minimal spontaneous communication.

Following the implementation of the KAAYA intervention, improvements were observed across all communication indicators. In the posttest phase, the child achieved the maximum score of 3 for requesting eating, requesting toileting, and requesting play, indicating consistent and appropriate activation of KAAYA buttons to express these basic needs. The score for initiating interaction increased from 1 to 2, indicating an improvement in the child's ability to initiate communication, although this skill was still less developed than need-based requests. Overall, the total communication score increased substantially from 6 in the pretest to 11 in the posttest, demonstrating a clear enhancement in the child's functional and expressive communication abilities following the KAAYA intervention.

### Weekly Communication Performance

Weekly communication performance was examined to describe changes in the child's communication abilities over the three-week intervention period. Mean communication scores were calculated based on daily observations conducted during classroom activities each week. As presented in Table 2, the child's mean communication score showed a gradual upward trend across the intervention period. In Week 1, the mean score was 2.00, indicating that the child primarily relied on gestural or nonverbal communication and was still in the early stages of using the KAAYA device. During Week 2, the mean score increased slightly to 2.06, reflecting emerging use of KAAYA buttons with occasional prompting. By Week 3, the mean score further increased to 2.09, suggesting more consistent and independent use of KAAYA to express basic needs. Although the numerical increase across weeks appears modest, the progressive trend indicates steady improvement in functional communication performance. This pattern suggests that continued exposure and practice with the KAAYA device supported gradual gains in communication abilities throughout the intervention period.

**Table 2.** Weekly Mean Communication Scores

Week	Mean Score
Week 1	02.00
Week 2	02.06
Week 3	02.09

Table 2 presents the child's weekly mean communication scores, calculated from daily observation data collected throughout the three-week intervention period. The table shows a gradual increase in mean scores across the intervention weeks, indicating

progressive improvement in communication performance. In Week 1, the mean score was 2.00, reflecting that the child predominantly relied on gestural or nonverbal communication and was still in the early phase of adapting to the KAAYA device. In Week 2, the mean score increased to 2.06, suggesting emerging use of KAAYA buttons with reduced reliance on prompts. By Week 3, the mean score further increased to 2.09, indicating more consistent and independent communication behaviors during classroom activities. Although the numerical increase in mean scores appears small, the upward trend across weeks indicates steady progress in the child's functional communication abilities. These findings suggest that repeated exposure to and practice with the KAAYA device contributed to gradual improvements in communication performance throughout the intervention period.

### Single-Case Time-Series Data

Session-by-session observations were conducted to capture the progression of the child's communication behavior throughout the intervention period. Each session score represented the dominant communication behavior observed during daily classroom activities.



**Figure 2.** Session-by-Session Communication Scores

Figure 2 illustrates the child's communication performance across individual intervention sessions, providing a detailed time series representation of changes in communication behavior throughout the study. Each data point represents the dominant communication behavior observed during a single session, as defined by the communication rubric. During the initial sessions (S1–S3), the communication scores remained at the lowest level, indicating that the child relied exclusively on gestures and nonverbal behaviors and did not activate the KAAYA buttons. Beginning in Session 4, communication scores increased, reflecting the child's initial engagement with the KAAYA device. From the mid-

intervention sessions onward, communication scores fluctuated slightly but remained above baseline, suggesting emerging consistency in using KAAYA to express basic needs. In the later sessions, the scores stabilized at a higher level, indicating more frequent and independent activation of KAAYA buttons during classroom activities. Overall, the session-by-session data demonstrate a clear upward trend in communication performance throughout the intervention period, supporting the effectiveness of the KAAYA intervention in facilitating gradual, sustained improvements in the child's functional and expressive communication abilities.

### Effect Size

To quantify the magnitude of the KAAYA intervention effect on the child's communication performance, an effect size analysis was conducted using the Percentage of Nonoverlapping Data (PND) method. This method is commonly used in single-case Research to compare baseline and intervention-phase data and to determine the extent to which intervention outcomes exceed baseline performance.

**Table 3.** Effect Size Analysis Using Percentage of Nonoverlapping Data (PND)

Component	Description
Baseline phase	Pretest communication performance
Highest baseline score	2.0
Total intervention sessions	15
Sessions exceeding baseline	12
Percentage of Nonoverlapping Data (PND)	80%
Interpretation	Effective intervention

Table 3 presents the effect size results of the KAAYA intervention based on the PND analysis. The highest communication score observed during the baseline phase was 2.0, which served as the reference point for identifying nonoverlapping intervention data. Of the 15 intervention sessions, 12 sessions produced communication scores that exceeded the highest baseline score. This resulted in a PND of 80%. According to commonly used interpretation criteria for PND, values above 70 percent indicate an effective intervention. Therefore, the results in Table 3 demonstrate that the KAAYA intervention had a strong, meaningful effect on the child's functional and expressive communication performance. These findings provide quantitative support for the visual trends observed in the session-by-session communication data.

### Qualitative Findings

Qualitative findings were obtained from structured classroom observations and interviews with teachers and parents to explore changes in the child's communication behavior and perceptions of KAAYA use. The analysis identified three main themes reflecting the intervention's impact on functional communication and social participation.

### a. Independence in Communication

Teachers reported increased independence in the child's communication following the intervention. Prior to using KAAYA, the child often relied on unclear gestures and required repeated prompts to express needs. After the intervention, the child was able to independently activate KAAYA buttons to convey needs without waiting for assistance. As one teacher stated, *"She now communicates her needs without waiting for repeated prompts"* (Teacher). This finding indicates that KAAYA supported more autonomous communication during classroom activities.

### b. Improved Toileting Communication

Both teachers and parents consistently reported improved clarity in communication about toileting. Teachers observed that the child pressed the toileting button instead of displaying restlessness or ambiguous behaviors. One teacher noted, *"She presses the toileting button instead of becoming restless"* (Teacher). Similarly, parents reported clearer communication at home, allowing them to respond more quickly, as expressed by one parent, *"We can immediately understand when she needs to go to the toilet"* (Parent). These findings suggest that KAAYA reduced miscommunication related to basic needs.

### c. Social Interaction and Participation

"Positive changes in social interaction were also evident after the intervention. Parents reported increased engagement during play activities, while teachers observed improved participation in group learning situations. These findings align with research by Biggs et al (2017), who found that structured peer support arrangements combined with AAC accessibility significantly increased both peer interactions and AAC use among students with complex communication needs in inclusive classroom settings. One parent stated, *'She interacts more with her peers during playtime'* (Parent), and a teacher added, *'Her participation during group activities has improved'* (Teacher)."

Overall, the qualitative findings demonstrate that the KAAYA intervention contributed to increased independence, reduced miscommunication, and enhanced social participation, supporting the social validity of KAAYA as a communication support tool.

### Social Validity

In relation to the second Research question, which examined teachers' and parents' perceptions of the usability and social validity of KAAYA as a communication support tool, social validity data were collected through post-intervention interviews and classroom observations. The findings indicate that both teachers and parents perceived KAAYA as easy to use, practical, and suitable for daily routines in both school and home contexts.

Teachers reported that KAAYA's wearable design ensured continuous accessibility throughout classroom activities, enabling a quicker, clearer understanding of the child's

needs without interrupting instruction. Parents similarly reported that KAAYA facilitated clearer communication at home, reduced misunderstandings, and supported more immediate responses to the child's requests. In addition, both groups viewed KAAYA as socially acceptable and appropriate for the child's age and learning context, noting that the simple pictorial symbols and child-friendly design supported consistent use without causing discomfort or stigma.

Overall, these findings directly address the second Research question by demonstrating that KAAYA showed high social validity and usability, as perceived by key stakeholders, and was considered an acceptable and beneficial communication support tool across educational and home settings.

### **Supporting Evidence from Prior Studies**

The findings of this study are consistent with prior Research on the use of Augmentative and Alternative Communication interventions for children with intellectual and developmental disabilities. Previous studies have reported that AAC tools, particularly those using picture-based and low-tech formats, can improve functional communication, independence, and social participation when implemented consistently in daily routines. Research by [Rizqita et al \(2022\)](#) demonstrated that picture-based AAC media supported children's ability to express basic needs such as eating and toileting. At the same time, [Purba et al.](#) reported improvements in expressive communication through vocabulary-based visual supports in special school settings.

In addition, studies focusing on AAC accessibility have emphasized that communication tools are more effective when they are readily available during natural activities. This aligns with findings reported by [Elmqvist et al \(2023\)](#) and [Riswari et al \(2022\)](#), who highlighted the importance of consistent access and adult modeling in facilitating AAC use. The present findings support these conclusions by showing that KAAYA's wearable design enabled continuous accessibility and supported more consistent communication attempts across sessions. Overall, the results of this study reinforce existing evidence that low-tech AAC interventions can produce meaningful improvements in functional communication, particularly when designed to fit the daily contexts of children with intellectual disabilities.

### **D. Discussion**

The results of this study indicate that the KAAYA wearable AAC device was associated with meaningful improvements in the child's functional and expressive communication abilities. The comparison between pretest and posttest scores, supported by session-by-session data, shows that KAAYA enabled the child to express basic needs more clearly and consistently. The gradual shift from gestural communication in the early sessions toward independent activation of KAAYA buttons in later sessions suggests a positive change in daily communication patterns. Reduced miscommunication, fewer toileting

difficulties, and increased social interaction with teachers and peers accompanied these improvements. Overall, the findings suggest that introducing a low-tech wearable AAC device can support functional communication outcomes for children with mild intellectual disabilities in structured educational environments.

From a theoretical perspective, these findings align with the fundamental principles of Augmentative and Alternative Communication (AAC), which emphasize the use of external tools whether low-tech or high-tech to support or replace verbal communication for individuals with communication challenges. AAC theory highlights that communication becomes more effective when tools are accessible, consistently available, and embedded within daily routines. In this study, KAAYA's wearable format ensured constant physical accessibility, allowing the child to communicate spontaneously during activities such as eating, playing, and transitions. The progression observed in the time-series data, from exclusive reliance on gestures to independent button use, supports the notion that AAC tools facilitate functional, real-time expression when they are readily available and easy to operate.

The present findings are further supported by previous research on low-tech AAC interventions. [Rizqita et al \(2022\)](#) and [Fitriani et al \(2019\)](#), and [Dewi et al \(2019\)](#) reported that picture-based AAC media enhanced children's ability to express basic needs, including hunger and toileting, through picture-based supports. [Aisy et al \(2024\)](#) also developed J-NEEDS, an alternative and augmentative communication system for children with multiple disabilities, demonstrating effectiveness in improving functional communication. Similarly, [Purba et al \(2019\)](#) found that vocabulary-based picture cards improved expressive communication among children with mild intellectual disabilities. While these studies demonstrate the effectiveness of non-wearable AAC formats, the current study extends prior research by showing that a wearable low-tech AAC device can provide comparable benefits while offering greater accessibility throughout daily activities. The effectiveness of AAC interventions is influenced by multiple factors. [Rose et al \(2020\)](#) identified several predictors of expressive language change for children with autism receiving AAC-infused interventions, including baseline receptive language abilities, environmental support, and consistency of implementation – factors that align with the present study's design.

Comparisons with more recent studies also reinforce KAAYA's effectiveness. [Elmqvist et al \(2023\)](#) emphasized that AAC tools are most effective when they are available during natural routines, allowing children to communicate needs as they arise. KAAYA's wearable design directly addresses this recommendation by eliminating the need to locate or retrieve communication materials. In addition, [Riswari et al \(2022\)](#) highlighted the importance of teacher modeling in increasing expressive communication attempts. In the present study, teachers played a central role in modeling and prompting the child to use KAAYA buttons, which may have supported the gradual increase in independent communication observed across sessions. Furthermore, [Putri et al \(2023\)](#) noted that AAC interventions yield stronger outcomes when there is consistency between school and home

environments. This finding is consistent with the present study, which found that both teacher and parent reports indicated clearer communication and reduced frustration.

Beyond theoretical alignment, the effectiveness of KAAYA should also be interpreted within the sociocultural context of Indonesian special schools (SLB). In Indonesian SLB settings, teachers often serve not only as instructors but also as primary communication facilitators for children with disabilities. The success of KAAYA in this study was supported by intensive teacher involvement through repeated modeling, prompting, and reinforcement—practices that are consistent with the relational and interactional norms of special education in Indonesia. Moreover, the simplicity and low-cost nature of KAAYA made it culturally and practically appropriate for both school and home use, particularly in contexts where access to high-tech AAC devices may be limited.

Overall, this study demonstrates that KAAYA is effective not only because of its technical design but also because it aligns with AAC principles, classroom routines, and sociocultural practices typical of Indonesian special education. The findings reinforce the importance of developing AAC tools that are accessible, low-cost, and adaptable to daily routines. As a wearable low-tech AAC device, KAAYA contributes to the AAC field by offering a contextually appropriate alternative that supports functional communication and social participation for children with mild intellectual disabilities.

## E. Implication

The findings of this study have important theoretical, practical, and policy implications. Theoretically, the results support the view of education as a structured process of humanization grounded in meaningful experience that fosters learner independence, as articulated by Dewey and subsequent scholars (Arifin, 2003). This perspective is also reflected in Islamic educational philosophy, which emphasizes the development of functional skills and social participation as essential components of human development, particularly for individuals with special needs (Alfazri et al., 2024). The observed improvements through KAAYA demonstrate that when children with communication challenges are provided with appropriate and accessible tools, their participation in daily routines becomes more meaningful and autonomous. These findings align with core principles of special needs education, which emphasize that children with intellectual disabilities require individualized and functional supports beyond conventional instructional approaches. KAAYA functions as such an individualized support by addressing communication barriers that otherwise limit participation in learning activities. Furthermore, the outcomes reinforce fundamental principles of Augmentative and Alternative Communication theory, particularly the importance of accessibility, simplicity, and contextual integration. KAAYA's wearable and continuously available design provides practical confirmation that AAC tools are most effective when they can be used spontaneously within natural communication contexts.

From a practical perspective, KAAYA offers clear benefits for teachers, parents, and practitioners. In special school settings, where teachers often act as both instructors and

communication facilitators, KAAYA supports clearer interpretation of children's needs and smoother daily transitions. The device enables children to express essential needs such as eating, playing, and toileting more clearly, reducing frustration and preventing communication-related behavioral difficulties. These findings highlight that effective AAC support does not necessarily require advanced technology, as a low-cost, culturally adaptable tool like KAAYA can yield meaningful improvements when used consistently across settings.

At the policy and educational level, the findings underscore the importance of ensuring access to affordable AAC tools to support inclusive education. Schools may benefit from incorporating AAC modeling and usage strategies into teacher training programs, particularly in special school contexts. Given its practicality, low cost, and contextual suitability, KAAYA represents a scalable communication support model that can be expanded across educational settings with limited access to high-technology AAC resources.

## **F. Limitation and Suggestion for Further Research**

This study has several limitations that should be considered when interpreting the findings. Using a single participant limits the generalizability of the results, as individual characteristics and familiarity with the school environment may influence the observed improvements. In addition, KAAYA was implemented solely in the classroom, leaving uncertainty about the maintenance and generalization of communication gains in home or community settings. The absence of a control or comparison condition also limits the extent to which the observed improvements can be attributed solely to the KAAYA intervention, as other factors such as natural development, teacher modeling, or environmental consistency may have contributed.

The study also did not compare KAAYA with other AAC modalities or examine how the device interacted with unaided communication behaviors such as gestures or facial expressions. Furthermore, the Research was conducted in a single special school setting, which restricts the exploration of cultural, relational, and contextual influences across diverse educational environments.

Despite these limitations, the findings suggest several directions for future Research. Studies involving larger, more diverse samples are needed to strengthen external validity and evaluate KAAYA across different types and levels of disability. Comparative studies between KAAYA and other low-tech or high-tech AAC systems would provide deeper insight into relative effectiveness. Longitudinal Research across school, home, and community settings is also recommended to examine the sustainability of communication gains. Future studies may further explore KAAYA's adaptability for children with other developmental conditions to assess its broader applicability as a wearable AAC solution.

## G. Conclusion

This study concludes that KAAYA was successfully developed as a wearable, low-tech Augmentative and Alternative Communication device that is functional, accessible, and feasible for use by a child with mild intellectual disability. The findings demonstrate that KAAYA use contributed to meaningful improvements in the child's functional and expressive communication abilities, particularly in expressing basic needs such as eating and toileting, and in initiating simple interactions. These improvements were evidenced by pretest and posttest comparisons, weekly performance trends, session-by-session data, and effect-size analyses, all of which indicated a positive and consistent impact of the intervention.

In addition to quantitative gains, qualitative findings revealed increased independence, reduced miscommunication, and improved social interaction in both school- and home-related contexts. Teachers and parents perceived KAAYA as easy to use, practical, and socially acceptable, supporting its high social validity as a communication support tool. The wearable design ensured continuous accessibility, which facilitated spontaneous and functional communication during daily activities.

Overall, this study highlights the potential of low-cost and contextually appropriate AAC solutions to support communication development among children with mild intellectual disabilities. KAAYA represents a promising alternative for educational settings with limited access to high-technology AAC tools and offers practical implications for teachers, parents, and practitioners seeking effective communication supports within structured learning environments.

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