

## **Analysis of the Needs of Interactive Learning Media for Early Reading for Children with Autism in Special Schools**

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**Abstract:** Early reading skills are a fundamental component of children's literacy development, including for children with autism who require adaptive and individualized learning approaches. However, learning media used in Special Needs Schools (SLB) are still predominantly conventional and less effective in maintaining students' attention and engagement. This study aims to analyze the needs for interactive learning media in early reading among children with autism, drawing on teachers' experiences, observations of student behavior, and perceptions of technology use. This study employed a mixed-methods sequential explanatory design involving four special education teachers and four children with autism aged 6–9 years in a special school. Data were collected through Likert-scale questionnaires, classroom observations, and semi-structured interviews, and analyzed using descriptive statistics and thematic analysis. The findings indicate that children with autism tend to respond more positively to visual and kinesthetic stimuli compared to auditory input, and show higher engagement when learning involves animations and real-time audio support. Teachers also perceived that conventional media are less effective in sustaining students' focus, and expressed a strong need for more interactive and multisensory learning media. In particular, teachers highlighted the potential of Augmented Reality (AR)-based phonics media to support more engaging learning experiences. However, it is important to note that this study is limited to a needs analysis and does not examine the effectiveness of AR-based interventions. Therefore, the findings should be interpreted as reflecting teacher perceptions and contextual needs rather than evidence of impact. This study contributes by providing an empirical basis for the development of interactive and technology-based learning media and supporting the application of the Universal Design for Learning (UDL) framework. Further research is recommended to develop and experimentally evaluate AR-based phonics media for early literacy learning in children with autism.

**Keywords:** autism, early reading; interactive learning media; Augmented Reality; learning needs.

### **INTRODUCTION**

Education for children with special needs, particularly those on the autism spectrum, requires adaptive, individualized, and needs-based learning approaches (Zaic, 2021; Khoirunnisa, 2023). Children with autism demonstrate diverse characteristics, including differences in communication, social interaction, sensory processing, and learning preferences (Silveira-Zaldivar et al., 2021; Boyle et al., 2019). This variability within the autism spectrum implies that instructional strategies, especially in early literacy, must be flexible and responsive to individual learning profiles rather than relying on uniform approaches (Zasacka & Bulkowski, 2017).

Early reading is a foundational skill that supports not only academic achievement but also communication and social participation. For children with autism, early reading development is often associated with specific challenges, such as limited attention span, difficulty in connecting letters to phonemes, and reduced engagement with repetitive or static learning activities (Justitie et al., 2005; Tárraga-Mínguez et al., 2021). These challenges suggest that conventional instructional approaches may not adequately address their learning needs, particularly when the media used lack sensory stimulation and interactivity.

Previous studies have consistently highlighted the importance of multisensory learning approaches integrating visual, auditory, and kinesthetic modalities in supporting literacy development among children with special needs (Zwoli et al., 2023). Visual supports, for instance, have been shown to enhance attention and comprehension, while kinesthetic activities can facilitate engagement and retention. However, auditory processing remains a

challenge for many children with autism, especially when presented in isolation without visual reinforcement (Yenioglu et al., 2023). These findings indicate that effective early reading instruction for children with autism should not rely on a single modality but rather on integrating multiple sensory channels (Kurniawan et al., 2022; Jdaitawi & Kan'an, 2022).

In parallel, advances in educational technology have introduced interactive digital media, including Augmented Reality (AR), as potential tools to support learning for children with special needs (Guldborg, 2017; Musayaroh et al., 2016). Several international studies suggest that AR can provide immersive, interactive learning experiences by combining visual, auditory, and tactile elements. Nevertheless, these studies are largely conducted in controlled or technologically supported environments, and their applicability to local contexts, particularly in Indonesian Special Needs Schools (SLB), remains uncertain.

In the Indonesian context, learning media for early reading in SLB are still predominantly conventional, such as letter cards, printed books, and basic visual aids. While these media are accessible and widely used, they often struggle to sustain students' attention and engagement over time. This creates a mismatch between the learning characteristics of children with autism, who tend to benefit from dynamic and multisensory input, and the available instructional media in classrooms.

Although prior research has explored the use of interactive and digital media in special education, there remains limited empirical evidence specifically examining the contextual needs of early reading media for children with autism in Indonesian SLB settings. In particular, few studies have integrated teacher perspectives, classroom observations, and student learning behavior to provide a comprehensive understanding of these needs. As a result, the development of innovative media, including AR-based phonics applications, often lacks a strong empirical foundation grounded in local educational contexts.

Based on this gap, the present study aims to analyze the needs of interactive learning media for early reading among children with autism in a special school context (Mundiri & Hamimah, 2022). By employing a mixed-methods approach that combines teacher questionnaires, classroom observations, and semi-structured interviews, this study aims to provide a systematic, evidence-based mapping of learning media needs (Auliakhasanah et al., 2023).

This study is expected to contribute theoretically by strengthening the application of the Universal Design for Learning (UDL) framework to early literacy for children with autism. Practically, the findings can inform teachers, educational media developers, and policymakers in designing more inclusive and contextually relevant learning media. It is important to emphasize that this study focuses on identifying needs rather than testing the effectiveness of specific interventions; therefore, the results should be interpreted as a foundational step for future development and experimental research.

## **METHOD**

### **Research Design**

This study employed a mixed-methods approach using a sequential explanatory design (Creswell & Clark, 2017), in which quantitative data were collected and analyzed in the first phase, followed by qualitative data to further explain and elaborate on the quantitative findings. The integration of both datasets was conducted sequentially, with qualitative results used to interpret and deepen the quantitative results.

### **Location and Participants**

The study was conducted at SLB Negeri Bintan, located in Bintan Regency, Riau Islands Province, Indonesia. This school represents a typical special education setting where conventional learning media are commonly used.

The participants consisted of four special education teachers who teach children with autism at the elementary level (SDLB). All participants held a bachelor's degree in Special Education and had at least one year of teaching experience with students with autism. In addition, observational data were collected from four students with autism, aged 6–9 years, whom these teachers taught.

Given the small number of participants, the findings of this study are not intended for broad generalization but rather to provide an in-depth, context-specific understanding of learning media needs.

### **Research Instruments**

Three instruments were used to collect data:

#### 1. Teacher Questionnaire

A questionnaire consisting of 20 closed-ended statements using a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree), complemented by several open-ended questions. The questionnaire was designed to capture teachers' perceptions of students' reading difficulties, the effectiveness of conventional media, students' sensory preferences (visual, auditory, kinesthetic), and expectations regarding interactive learning media.

#### 2. Observation of Students' Reading Behavior

Classroom observations were conducted using an observation sheet containing 20 indicators. The observed aspects included visual response, auditory response, kinesthetic engagement, learning focus, and motivation.

It is important to note that the teachers conducted the observations during regular classroom activities. While this approach allowed for naturalistic data collection, it may also introduce subjectivity in scoring.

#### 3. Semi-structured Interviews

Semi-structured interviews were conducted with all participating teachers using an interview guide consisting of 20 open-ended questions. The interviews explored teachers' experiences in teaching early reading, challenges encountered, and their perspectives on ideal learning media for children with autism.

### **Validity and Reliability**

The research instruments were validated by two experts in special education and one practitioner. The validation results showed an Aiken's *V* coefficient of 0.87, indicating high content validity. The reliability of the questionnaire was assessed using 10 special education teachers outside the main sample, yielding a Cronbach's  $\alpha$  of 0.82, indicating good internal consistency.

### **Research Procedure**

The study was conducted in three stages:

#### 1. Quantitative Phase

Teachers completed the questionnaire and conducted classroom observations of students' reading behavior during regular instructional sessions. Observations were conducted across multiple learning sessions to capture typical student responses.

## 2. Qualitative Phase

Semi-structured interviews were conducted after the quantitative data were analyzed to explain and provide deeper insights into the quantitative findings.

## 3. Data Integration

The integration of quantitative and qualitative data followed a sequential explanatory approach, where qualitative findings were used to interpret and support the quantitative results.

## Data Analysis

Quantitative data were analyzed descriptively using mean scores, percentages, and score distributions to identify patterns in students' responses and teachers' perceptions. Qualitative data were analyzed using thematic analysis (Lochmiller, 2021), which involved data transcription, open coding, categorization, and theme development. To enhance the credibility of the findings, data triangulation was conducted by comparing results from questionnaires, observations, and interviews. Member checking was also performed by confirming the interview results with participants.

## Research Limitations

Several limitations should be acknowledged. First, the small sample size limits the transferability of the findings to broader contexts. Second, observational data were collected by teachers rather than independent researchers, which may introduce subjective bias. Third, this study focuses on needs analysis and does not examine the effectiveness of specific learning media interventions. Therefore, the findings should be interpreted within the scope of identifying contextual needs rather than evaluating instructional outcomes.

## FINDING AND DISCUSSION

### Finding(s)

The findings of this study are presented based on three data sources: classroom observations, teacher questionnaires, and semi-structured interviews. The results are described sequentially to provide a comprehensive overview of the early reading learning media needs of children with autism.

### *Observation Results of Students' Reading Behavior*

Classroom observations indicate that students with autism demonstrated varying responses across sensory modalities. Overall, students appeared to respond more positively to visual and kinesthetic stimuli compared to auditory input.

The average observation scores show that the visual response obtained a mean score of 3.2, the kinesthetic response 3.0, and the auditory response 2.8. Meanwhile, learning focus and motivation were relatively moderate, with scores of 2.7 and 2.9, respectively. These results suggest that students were generally able to attend to visual stimuli, such as letters and images, and follow simple physical instructions. However, their responses to auditory stimuli, particularly phonemic sounds, were less consistent.

In addition, observations indicated that students tended to lose focus after approximately 15-20 minutes of learning activities, particularly when using static and repetitive media. This finding suggests that maintaining attention remains a challenge in early reading instruction for children with autism.

**Table 1. Observation Results of Students with Autism's Reading Behavior.**

Observed Aspect	Average Score (1–4)	Interpretation
Visual Response	3.2	Relatively good, students can pay attention to letters and pictures, although their attention is easily distracted.
Auditory Response	2.8	Only some students can imitate phonemic sounds, often stopping midway through practice.
Kinesthetic Response	3.0	Students can point to letters or follow simple instructions, but not consistently.
Learning Focus	2.7	Limited attention span; students lose focus after approximately 15–20 minutes
Motivation/Enthusiasm	2.9	More enthusiastic when learning involves media with sound and animations

Overall, while differences across modalities were observed, the score range was relatively narrow. Therefore, these findings should be interpreted as indicating tendencies rather than substantial differences in learning responses.

**Table 2. Summary of Teacher Questionnaire Results (N=4)**

Assessed Aspect	Average Score (1–4)	Interpretation
Students' Reading Difficulty (letter–sound)	3.5	The level of difficulty in early reading is quite high
Effectiveness of Conventional Media (books, cards)	2.5	Traditional media is less effective; students get bored quickly
Children's Preference for Pictures/Visuals	3.8	Colored visuals help students understand more effectively
Children's Preference for Sound/Phonics	3.0	Students need clear, repetitive, and slow sounds
Children's Preference for Animation/Movement	3.6	Animations capture attention for a longer time
Teachers' Expectation for Interactive Phonics Media (AR)	3.9	Teachers strongly expect AR-based phonics media

### ***Interview Results***

The interview findings provide deeper insight into teachers' experiences and perspectives. Teachers consistently reported that students with autism tend to lose interest when learning activities rely on conventional media such as books and letter cards. As one teacher explained, "Children get bored quickly if they only use letter cards; they need something that moves or produces sound."

Teachers also emphasized the importance of multisensory learning. Several participants noted that students responded more actively when learning involved a combination of visual and auditory elements. For example, one teacher stated, "Children respond more quickly when there are sounds and images at the same time." This suggests that integrating multiple sensory modalities may support greater engagement in early reading activities.

In addition, teachers expressed expectations for more interactive and technology-based learning media. Some participants mentioned the potential of AR-based media to present letters with sound and movement in an integrated way. However, these views reflect expectations and perceived possibilities rather than experiences from actual implementation. Thematic analysis identified three main themes:

1. Limitations of conventional learning media
2. Preference for multisensory learning approaches
3. Expectations for interactive and technology-based media

The relationship between these themes is illustrated in Figure 1

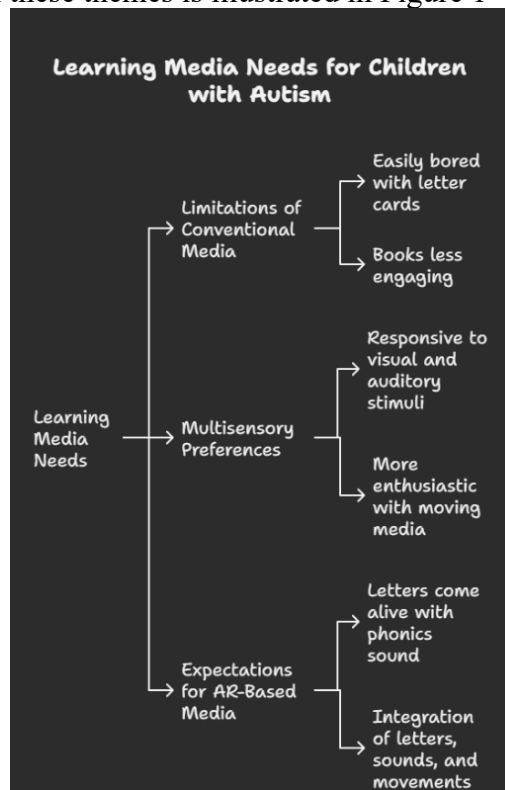


Figure 1. Thematic Tree of Reading Media Needs for Children with Autism

### Summary of Findings

Overall, the findings suggest that children with autism tend to show greater responsiveness to visual and kinesthetic stimuli, while auditory processing remains relatively more challenging. Conventional learning media are perceived as less effective at maintaining attention and engagement, whereas multisensory and interactive media are considered more suitable for supporting early reading.

Importantly, the identified need for interactive media, including AR-based phonics applications, is grounded in teachers' perceptions and contextual observations. Therefore, these findings should be understood as a representation of learning needs rather than as evidence of the effectiveness of specific technological interventions.

### Discussion

The findings of this study indicate that children with autism tend to respond more positively to visual and kinesthetic stimuli compared to auditory input. This tendency is consistent with previous studies suggesting that many children with autism prefer visual information processing and benefit from structured visual supports (Windy Yolanda, 2021). Visual elements, such as clear images and symbols, can help maintain attention and reduce cognitive load, particularly in early reading activities.

The relatively lower auditory response observed in this study also aligns with the existing literature, indicating that children with autism may have challenges processing auditory information, especially when it is presented without accompanying visual cues (Hartley et al., 2019). This suggests that relying solely on phonemic instruction without visual reinforcement may limit students' engagement and comprehension. Therefore, the

integration of visual and auditory elements becomes essential in supporting early reading development.

In addition, the findings highlight the limitations of conventional learning media, such as textbooks and letter cards, which were perceived as less effective in sustaining students' attention. These media tend to be static and repetitive, offering limited sensory stimulation. As a result, students may lose focus more quickly, as reflected in both observation and interview data. This supports previous research indicating that traditional instructional media may not adequately meet the learning needs of children with developmental differences.

The importance of multisensory learning approaches was strongly emphasized across all data sources. Teachers reported that students showed higher engagement when learning activities incorporated visual, auditory, and kinesthetic elements. This finding is in line with the VAKT (Visual, Auditory, Kinesthetic, Tactile) approach, which has been widely recognized as an effective strategy for supporting literacy development in children with special needs (Nordin et al., 2024). By engaging multiple sensory pathways simultaneously, multisensory learning may facilitate better understanding and retention of early reading concepts.

Another important finding relates to teachers' expectations for more interactive and technology-based learning media. In particular, teachers expressed interest in the potential use of Augmented Reality (AR) to integrate visual, auditory, and interactive components into a single learning experience. This reflects a perceived need for more dynamic and engaging instructional tools that can better align with students' learning characteristics (Mais & Abadi, 2018).

However, it is important to interpret these expectations with caution. This study did not implement or evaluate AR-based learning media; therefore, the findings do not provide empirical evidence of AR's effectiveness in improving early reading skills. Instead, AR should be understood as one of several potential approaches that may support multisensory learning, rather than as a definitive solution.

Furthermore, the feasibility of implementing technology-based media, including AR, in special education settings should also be considered. Factors such as teacher readiness, availability of technological infrastructure, access to devices, and institutional support may influence the successful adoption of such media in practice. In many SLB contexts, these factors may vary significantly, which suggests that the development of learning media should be adapted to the specific conditions of each educational setting.

From a theoretical perspective, this study contributes to the application of the Universal Design for Learning (UDL) framework by emphasizing the importance of providing multiple means of representation and engagement. The identified preference for multisensory input supports the idea that flexible and inclusive instructional design is essential for accommodating diverse learning needs, particularly among children with autism.

In terms of practical implications, the findings suggest that teachers may begin by optimizing the use of available resources, such as incorporating simple visual aids, animations, and audio support, even without advanced technology. For educational media developers, the results provide an initial empirical basis for designing interactive learning tools that integrate multiple sensory modalities. However, further development should be followed by systematic testing to evaluate usability and effectiveness.

Despite its contributions, this study has several limitations. The small number of participants limits the transferability of the findings, and the use of teacher-reported observations may introduce subjective bias. In addition, as this study focuses on needs analysis, it does not assess learning outcomes or intervention effectiveness. Therefore, future research is recommended to develop prototypes of interactive learning media and examine their impact through experimental or quasi-experimental designs involving a larger number of participants.

## CONCLUSION

This study aimed to analyze the needs of early reading learning media for children with autism in a special school context using a mixed-methods approach. The findings indicate that students with autism tend to respond more positively to visual and kinesthetic stimuli, while auditory processing remains relatively more challenging. In addition, conventional learning media, such as textbooks and flashcards, are perceived as less effective at maintaining students' attention and engagement during learning activities.

The results also highlight the importance of multisensory learning approaches that integrate visual, auditory, and kinesthetic elements to better support early reading development. Teachers expressed a strong need for more interactive learning media that can accommodate these multisensory characteristics. In this context, technology-based media, including Augmented Reality (AR), were identified as having the potential to support more engaging and integrated learning experiences.

However, it is important to emphasize that this study is limited to a needs analysis and does not evaluate the effectiveness of any specific learning media, including AR-based interventions. Therefore, the findings should be interpreted as reflecting teacher perceptions and contextual needs rather than as evidence of instructional impact.

The main contribution of this study lies in providing an empirical foundation for understanding the learning media needs of children with autism in Indonesian special education settings. These findings can serve as a reference for teachers, developers, and policymakers in designing more inclusive and contextually relevant instructional media.

Future research is recommended to extend this study by developing interactive learning media prototypes and conducting experimental or quasi-experimental studies to evaluate their effectiveness in improving early reading skills among children with autism.

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