


The Effectiveness of Educational Games for Enhancing Early Reading Skills among Children with Intellectual Disabilities

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ABSTRACT

Early reading skills are essential for academic learning; however, children with mild intellectual disabilities frequently experience persistent difficulties in decoding simple syllabic word structures such as consonant-vowel-consonant-vowel (CV-CV), which limits their early reading development. This study aimed to examine the effectiveness of the GEMMAS educational game in improving early reading skills of children with mild intellectual disabilities. The study employed a Single Subject Research approach with an A-B-A design. The participant was a fifth-grade student with mild intellectual disabilities at Sekolah Luar Biasa Negeri 1 Yogyakarta. Data were collected through oral and performance tests and analyzed using visual graphical analysis. The results showed an improvement in reading skills from 0% during the baseline phase to a stable level of 60% after the intervention, indicating that the GEMMAS educational game effectively enhances early reading skills.

Keywords: *Educational Games, Early Reading Skills, Mild Intellectual Disabilities*

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INTRODUCTION

Children with mild intellectual disabilities often experience specific reading difficulties, including delays in early reading acquisition, particularly during the initial stages of literacy development (Di Blasi et al., 2019). These reading difficulties are closely associated with limitations in phonological processing and spoken language development, which affect children's ability to recognize, discriminate, and manipulate speech sounds accurately (Majerus et al., 2011; Wise et al., 2010). In addition, constraints in working memory capacity further hinder children's ability to retain and process letter-sound information during reading tasks, making decoding activities especially challenging for this population (Schuchardt et al., 2011).

As a consequence of these cognitive and linguistic limitations, children with mild intellectual disabilities frequently encounter difficulties in distinguishing similar letter forms, sequencing letters accurately, and establishing consistent phoneme-grapheme correspondences (Channell et al., 2013). These difficulties have a direct impact on decoding accuracy, particularly when children are required to read words with simple syllabic structures such as consonant-vowel-consonant-vowel (CV-CV), which demand precise integration of auditory and visual information during the reading process (Wise et al., 2010).

Nevertheless, previous research indicates that children with mild intellectual disabilities are still able to develop basic reading competence when instruction is appropriately adapted to their cognitive and linguistic characteristics. Although reading

development in this population generally progresses at a slower pace compared to typically developing peers, consistent, structured, and explicit instructional support has been shown to facilitate gradual improvement over time. Empirical evidence from studies focusing on phonological awareness and decoding-based interventions demonstrates positive effects on early reading outcomes among children with mild intellectual disabilities (Ratz & Lenhard, 2013; Van Tilborg et al., 2014).

Referring to initial observations at SLB Negeri 1 Yogyakarta, it was found that a child with the initials AZ, a fifth-grade SDLB student with mild intellectual disabilities, had not yet mastered the ability to read words with a KV-KV syllabic structure (consonant-vowel-consonant-vowel). In learning activities, teachers still relied on the spelling method. This condition poses a problem due to the child's limited working memory capacity (Handayani et al., 2021). The spelling method requires children to perform relatively complex cognitive processes, from recognizing letters, combining them into syllables, to forming complete words. In addition, children are also required to understand the difference between phoneme sounds and grapheme representations, for example in the syllable "ba" which in the spelling process is explained as be-a, in accordance with the characteristics of the Indonesian language.

On the other hand, research findings using a dual-route reading model show that children with mild intellectual disabilities tend to read by breaking words down into letters or phonemes, rather than recognizing words directly (Cohen, 2001). This reading pattern indicates that the phonological pathway is more dominant than the lexical or visual pathways in the word recognition process. Therefore, understanding these characteristics is an important basis for determining reading teaching methods that emphasize strengthening phonological skills in accordance with the abilities and needs of children with mild intellectual disabilities.

Based on the results of a literature review, there are several approaches to early reading instruction that have been proven to have a real impact in supporting the development of early reading skills in children with mild intellectual disabilities. Among them, phonics instruction is effective in improving decoding skills and word reading ability (Hill, 2016); direct instruction contributes to improving reading skills, particularly in distinguishing between vowels and consonants and combining them (Bagher et al., 2014); and explicit instruction has been shown to improve word reading ability (Alnahdi, 2015). These various approaches can be used as references in the early reading learning process for children with mild intellectual disabilities.

In line with this, early reading instruction cannot be carried out separately, but requires the support of effective and engaging learning media (Puspitarini & Hanif, 2019). The use of learning media can provide a more valuable learning experience, thereby helping children understand the material more easily and supporting the achievement of learning objectives (Sanaky, 2009). In Indonesia, learning media for early reading that has been widely researched for children with mild intellectual disabilities is dominated by visual media, such as flashcards (Anggraeni et al., 2022), puzzles (Lailatuz & Samawi, 2016), and picture word cards (Idawati, 2021). However, these media generally have limitations in providing intensive practice frequency and immediate feedback to children.

Meanwhile, research utilizing multimedia-based learning media is still relatively limited, including the use of educational games (Mulyana, 2023) and the Marbel Huruf mobile application (Nurcholis, 2018). Similar studies have also been conducted outside Indonesia, such as in Brazil (De Vasconcelos et al., 2020) and China (Li et al., 2024). However, the material presented in these media is still limited to Portuguese and Mandarin.

From a theoretical perspective, the effectiveness of educational games in early reading instruction for children with mild intellectual disabilities can be explained through established learning theories. Multisensory learning theory emphasizes the integration of visual, auditory, and kinesthetic stimuli to support information processing and retention, which is particularly beneficial for children with intellectual disabilities (Johnson & Mayer, 2009; Shams & Seitz, 2008). In addition, game-based learning theory highlights the role of engagement, repetition, and meaningful feedback in promoting sustained learning practice (Deterding, 2011; Gee, 2003). From a behaviorist learning perspective, immediate feedback and reinforcement

embedded in educational games can strengthen correct stimulus–response patterns and facilitate the acquisition of early reading skills (Alnahdi, 2015; Skinner, 1953).

Interactive multimedia-based learning media are increasingly being developed to support early reading learning for children with mild intellectual disabilities. A number of studies have reported the positive impact of educational games on motivation and basic literacy skills. However, their implementation and results still vary depending on the characteristics of the students and the learning context. In particular, empirical evidence examining the effectiveness of GEMMAS educational games in improving early reading skills, especially in CV-CV word patterns in children with mild intellectual disabilities, is still limited.

To address this gap, educational games for early reading learning are generally designed with adaptive features that adjust learning materials to students' reading ability development. The integration of gamification elements, such as feedback, points, levels, and challenges, aims to create a more engaging, interactive, and supportive learning environment for continuous practice (Mulyana, 2023). In addition, educational games also have the potential to increase children's learning motivation and active participation during the learning process (De Vasconcelos et al., 2020), which is greatly needed by children with mild intellectual disabilities. The GEMMAS game is also designed to be operable on Android devices with various specifications so that it can be used both at school and at home.

Given the theoretical relevance of multisensory, game-based, and behaviorist learning approaches, as well as the limited empirical evidence in special education contexts, this study aims to examine the effectiveness of the GEMMAS educational game in improving the early reading skills of children with mild intellectual disabilities, particularly in reading words with a consonant–vowel–consonant–vowel (CV–CV) syllable pattern.

METHOD

This study employed a Single Subject Research (SSR) approach to examine the effectiveness of the GEMMAS educational game in improving early reading skills of a child with mild intellectual disabilities. An A–B–A research design was applied, consisting of an initial baseline phase (A1), an intervention phase (B), and a second baseline phase (A2). The baseline phases were conducted to observe the participant's reading performance before and after the intervention, while the intervention phase was implemented to examine changes occurring during the application of the GEMMAS educational game. Improvements that emerged during the intervention phase and were maintained in the second baseline phase were interpreted as the effects of the intervention.

In accordance with the principles of Single Subject Research, the transition between research phases was determined by data stability rather than a predetermined number of sessions. Each phase was continued until the participant's reading performance demonstrated stable patterns, indicated by relatively consistent scores with minimal variability and no clear upward or downward trend across consecutive sessions (Sunanto, 2006). Data stability in this study was identified when at least three consecutive data points showed consistent performance, with approximately 80% of the data points falling within a $\pm 15\%$ range of the phase mean. Based on this criterion, the initial baseline phase (A1) consisted of 3 sessions, followed by 8 intervention sessions (B) and 6 sessions in the second baseline phase (A2).

The participant was a fifth-grade student with mild intellectual disabilities enrolled in a special school (Sekolah Luar Biasa Negeri) in Yogyakarta, Indonesia. The participant was selected based on initial classroom observations indicating difficulties in reading words with a consonant–vowel–consonant–vowel (CV–CV) syllabic structure. All instructional and assessment sessions were conducted individually in a familiar learning environment to minimize distractions and ensure consistency across sessions.

Early reading skills in this study were operationally defined as the accuracy of reading words with a consonant–vowel–consonant–vowel (CV–CV) syllabic structure. Reading accuracy referred to the participant's ability to correctly sequence and pronounce letters to form meaningful words without letter omission, substitution, or reversal. Performance was

measured using five target words in each session. Each correctly read word was scored as one point, while incorrect responses received zero points (Riyanto, 2020). The total score was then converted into a percentage to represent the participant's level of early reading performance in each session.

The intervention utilized GEMMAS (Game Edukasi Membaca Mudah dan Asik), an Android-based educational game developed to support early reading instruction for children with intellectual disabilities. The game integrates visual, auditory, and interactive elements to facilitate decoding practice for CV-CV word patterns. Learning activities include matching pictures with written words, arranging letters into correct word sequences, and reading words accompanied by audio pronunciation. Immediate feedback is provided through visual cues and sounds to reinforce correct responses and support error correction. Each intervention session using the GEMMAS game lasted approximately 20–25 minutes and was conducted under teacher supervision.

Data were collected through oral reading tests and performance-based assessments administered at the end of each session. The participant's reading performance was recorded and expressed as a percentage score. Data analysis was conducted using visual graphical analysis, following procedures commonly applied in Single Subject Research. The analysis included examination of data trends, levels, stability, and changes within and between conditions. Comparisons across phases were used to determine the effect of the GEMMAS educational game on early reading skills (Sunanto, 2006).

To clarify the data analysis procedures, visual analysis focused on three main aspects: level, trend, and stability of the data across phases. Level analysis examined changes in the mean performance between phases to identify differences in reading accuracy before, during, and after the intervention. Trend analysis was used to observe the direction of data patterns within each phase, indicating whether performance showed an increasing, decreasing, or stable tendency over time.

Stability analysis assessed the consistency of data points within each phase, with stable data indicated by minimal variability and the absence of a pronounced upward or downward trend. Improvement in early reading skills was determined when an increase in data level and a positive trend were observed during the intervention phase compared to the initial baseline phase, and when these gains were maintained during the second baseline phase (Sunanto, 2006).

FINDINGS AND DISCUSSIONS

Findings

Description of Early Reading Skills at the Baseline Stage

Baseline data collection on subject AZ was conducted on August 2–4, 2024. The assessment results showed that AZ reading ability was at level 3, which is complete mastery of the alphabet. The five words tested were susu, sapu, sawi, siku, and soda. During the test, AZ had difficulty arranging letters into words according to the pictures, so most of the definitions were not correct. The reading ability score showed stability at 0% with a category of frustration, indicating the need for intensive assistance. The error pattern that emerged was inaccuracy in the order of letters, for example, sawi became swia and sapu became spua. This shows that AZ still has difficulty in sequencing letters correctly.

Table 1. Baseline Data Results (A1)

Session	Date	Score	Achievement Level
1	August 2, 2024	0%	Frustrational
2	August 3, 2024	0%	Frustrational
3	August 4, 2024	0%	Frustrational

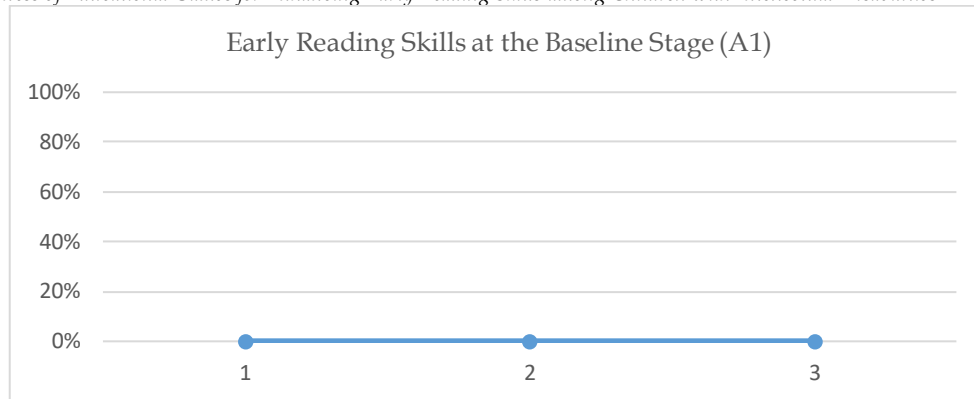


Figure 1. Early Reading Skills at the Baseline Stage

Based on Figure 1, the reading ability of subject AZ in the initial stage (A1) showed a stable data pattern during the first three meetings with a percentage of 0%. During the baseline phase, there were no significant changes in reading ability. This condition became the basis for continuing the study to the intervention phase (B).

Description of Early Reading Skills at the Intervention Stage

Subject AZ abilities showed significant improvement during the intervention phase, which took place from August 6 to 13, 2024. In terms of words with the KVKV syllable structure, subject AZ started with a score of 20% in the 4th session, which was still in the frustration category. However, there was an increase in the 7th session, with a score of 60%. This achievement was then consistently maintained until the 9th to 11th sessions, at 60%. The following are the intervention results obtained by subject AZ during these sessions.

Table 2. Intervention Results (B)

Session	Date	Score	Achievement Level
4	August 6, 2024	20%	Frustrational
5	August 7, 2024	20%	Frustrational
6	August 8, 2024	40%	Frustrational
7	August 9, 2024	60%	Frustrational
8	August 10, 2024	40%	Frustrational
9	August 11, 2024	60%	Frustrational
10	August 12, 2024	60%	Frustrational
11	August 13, 2024	60%	Frustrational

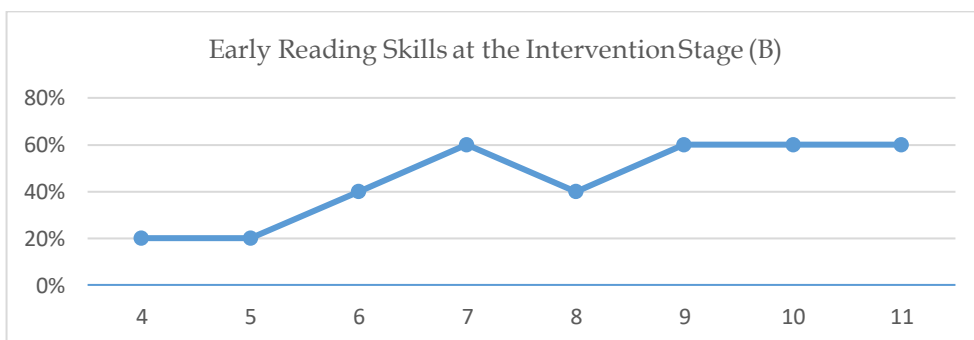


Figure 2. Early Reading Skills at the Intervention Stage (B)

Based on Figure 2, during the intervention phase (B), the reading ability of subject AZ showed a stable data pattern in sessions 9 to 11 with a percentage of 60%. In that range of sessions, the subject's reading ability did not show any significant fluctuations. Therefore, the study could proceed to the final baseline phase (A2).

Description of Early Reading Skills after the Intervention Stage

Baseline data collection on subject AZ was conducted from August 20 to 25, 2024. At this stage, subject AZ reading ability showed stability at a score of 60% with a category of frustrating achievement, indicating that subject AZ still needed intensive assistance. Subject AZ continued to display a pattern of errors in arranging letters into words in an incorrect order. For example, when asked to spell the word "sawi," subject AZ wrote it as "swia," and for the word "sapu," it was spelled as "spua." These errors indicate that subject AZ still has

difficulty in sequencing letters correctly. The following table presents subject AZ baseline data after intervention using the GEMMAS educational game.

Table 3. Baseline Data Results (A2)

Session	Date	Score	Achievement Level
12	August 20, 2024	40%	Frustrational
13	August 24, 2024	60%	Frustrational
14	August 25, 2024	80%	Frustrational
15	August 26, 2024	60%	Frustrational
16	August 28, 2024	60%	Frustrational
17	August 29, 2024	60%	Frustrational

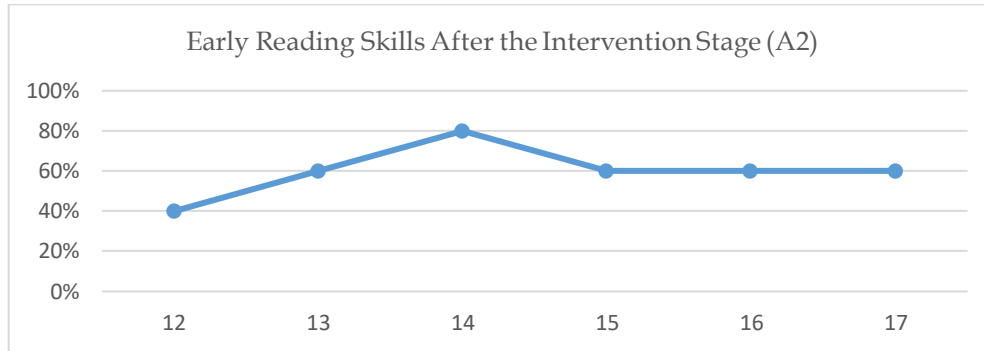


Figure 3. Early Reading Skills After the Intervention Stage (A2)

Based on Figure 3, the reading ability of subject AZ in the second baseline phase (A2) showed a stable data pattern from the 15th to the 17th meeting with a percentage of 60%. This data stability was indicated by the absence of changes in percentage values between meetings, so that the subject's reading ability tended to be consistent in that phase. Further discussion of the level of stability and characteristics of data changes is presented in the following data presentation.

Table 4. Recapitulation of Analysis Results for Each Condition

Condition	A1	B	A2
Length of condition	2	8	6
Trend Estimation			
Stability Trend	(=) 0% Unstable	(+) 25% Unstable	(+) 67% Unstable
Trends Data Trail			
Stability Level and Range	Variable 0% - 0%	Variable 20% - 60%	Variable 40% - 60%
Level of Change	0 - 0 = 0	60 - 20 = 40	60 - 40 = 20

Table 5. Recapitulation of Inter-Condition Analysis Results

Condition	A2/B/A1
Number of variables changed	1
Changes in directional trends and their effects	(=) (+) (+)
Changes in Data Stability	Unstable-Unstable-Unstable
Level of change	
a. Level of change in condition B/A1	20% - 0% = 20%
b. Level of change in condition B/A2	60% - 20% = 40%
Overlap percentage	
a. At baseline (A1) with intervention (B)	0%
	17%

b. At baseline (A2) with intervention

(B)

The results of the data analysis recapitulation show that the subjects early reading skills after the implementation of the GEMMAS educational game showed a stable data pattern and tended to increase compared to the initial baseline phase. This stability and improvement were reflected in the consistency of the reading ability percentage achieved during the intervention phase to the final baseline phase, as well as a reduction in data variation between sessions. Based on these findings, the GEMMAS educational game can be declared effective in supporting the development of children's early reading skills, particularly in maintaining the reading ability achievements obtained during the intervention.

Discussions

The findings of this study indicate that children with mild intellectual disabilities retain the potential to develop reading skills, even though they progress more slowly than typically developing peers. Previous research has shown that many children with mild intellectual disabilities can reach the alphabetic and orthographic stages of reading development, although reading fluency often remains a persistent challenge (Channell et al., 2013; Di Blasi et al., 2019; Ratz & Lenhard, 2013). This suggests that reading improvement is achievable when instructional approaches are appropriately aligned with learners' cognitive and linguistic profiles (Wise et al., 2010).

In the present study, the implementation of the GEMMAS educational game was associated with clear improvements in early reading performance. The presence of a stable baseline, followed by a noticeable increase during the intervention phase and maintained performance after withdrawal, indicates that these gains were likely the result of the instructional support provided through GEMMAS rather than occurring by chance. This pattern aligns with the logic of single-subject experimental designs, where changes across phases are interpreted as intervention effects.

These findings are consistent with previous research demonstrating the effectiveness of educational games and multimedia-based learning tools in supporting early reading development among children with mild intellectual disabilities. For example, De Vasconcelos et al., (2020) reported significant improvements in letter recognition and decoding skills through structured smartphone-based reading games. Guarnieri et al., (2019) found that interactive multimedia activities enhanced phonological awareness and word reading accuracy. Li et al., (2024) highlighted that mobile applications using multisensory feedback-combining visual, auditory, and interactive cues-effectively improved children's ability to read simple words and recall letter-sound correspondences. Mulyana, (2023) observed that game-based learning enhanced both reading accuracy and learner motivation, allowing sustained attention and repeated practice. Nurcholis, (2018) emphasized that educational games with repetitive exercises and immediate feedback helped children with intellectual disabilities achieve gains in decoding CV-CV word patterns. Collectively, these studies support the notion that structured, multisensory, and engaging game-based activities can enhance early reading skills, which mirrors the improvements observed in the present study using GEMMAS.

The effectiveness of GEMMAS can be further explained by its design features. The game provides structured, repetitive practice of CV-CV word patterns, supporting phonological processing and letter-sound correspondence, areas that are often challenging for children with mild intellectual disabilities. Its integration of visual and auditory supports aligns with multisensory learning principles, enhancing information processing and retention. Moreover, the interactive and game-based format increases motivation and engagement, encouraging active participation, sustained attention, and repeated practice in an enjoyable and low-pressure environment. These characteristics are consistent with prior findings that highlight the role of educational games in both skill acquisition and learner motivation, particularly for children requiring intensive practice and continuous support (Mulyana, 2023).

CONCLUSIONS

This study concludes that the GEMMAS educational game can serve as an effective instructional medium for supporting early reading development in children with mild intellectual disabilities, particularly in reading words with a consonant–vowel–consonant–vowel (CV–CV) syllabic structure. The findings indicate that interactive, game-based learning environments can facilitate meaningful improvement in early reading skills when instructional content is aligned with learners' cognitive characteristics. From an educational perspective, the findings suggest that special education teachers may consider integrating educational games such as GEMMAS into early reading instruction to provide structured practice, multisensory support, and immediate feedback. The use of technology-based learning media can help teachers create more engaging learning experiences and support repeated practice, which is essential for learners with mild intellectual disabilities. Collaboration between schools and parents is also encouraged to ensure consistent reading practice across school and home settings. Despite these positive findings, this study has several limitations that should be acknowledged. The results are based on a single subject, which limits the generalizability of the findings. In addition, the intervention focused only on words with a KV–KV structure, and reading fluency was not examined. Future research should involve multiple participants, extend the range of word structures, and include additional outcome measures such as reading fluency and comprehension to further evaluate the effectiveness of educational games in early reading instruction.

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