



Design and Validation of LexiPlay: A Multisensory Game-Based Application for Literacy Learning among Children with Dyslexia

Menik Tetha Agustina^{1*}, Pratama Irwin Talenta², M. Zakki Abdillah³

¹Psychology, Universitas Nasional Karangturi, Indonesia

Email: menik.tetha@unkartur.ac.id

²English Education, Universitas Nasional Karangturi, Indonesia

Email: pratama.irwin@unkartur.ac.id

³Information Systems, Universitas Nasional Karangturi, Indonesia

Email: zakki.abdillah@unkartur.ac.id

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Abstract

Children with dyslexia often experience difficulties in reading, spelling, and phonological processing, which may hinder their literacy development. Although various educational applications have been developed to support learning, many existing platforms do not sufficiently integrate multisensory learning principles and game-based features that are essential for supporting children with dyslexia. Therefore, this study aims to develop and validate *LexiPlay*, a multisensory game-based learning application designed to support literacy development among children with dyslexia, and to examine its validity and practicality as a learning medium. This study employed a Research and Development (R&D) approach based on the Borg and Gall model. Data were collected through observation, interviews, and documentation. The development process involved expert validation, instrument validation, individual trials, and small-group trials with students with dyslexia. The collected data were analyzed using both qualitative and quantitative approaches. The results indicate that the *LexiPlay* application achieved a “highly valid” classification based on expert evaluation and was considered “highly practical” based on limited field testing. The application integrates multisensory learning elements, gamification features, and a dyslexia-friendly interface, which contribute to improving student engagement and supporting early literacy learning. These findings suggest that *LexiPlay* has strong potential as an innovative digital learning tool to support literacy development in children with dyslexia and provide important implications for special education, inclusive education practices, and the development of evidence-based digital learning interventions.

*Corresponding author at: Department of Psychology, Faculty of Economics, Business, and Humanities, Universitas Nasional Karangturi, Semarang, 50127, Indonesia

E-mail address: menik.tetha@unkartur.ac.id

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INTRODUCTION

Dyslexia is widely recognized as a Specific Learning Disorder that affects an individual's ability to process written language and develop fluent reading skills (Snowling, Hulme, & Nation, 2020). The International Dyslexia Association defines dyslexia as a neurobiological learning disorder characterized by difficulties in accurate word recognition, spelling, and decoding abilities, typically resulting from deficits in the phonological component of language. These difficulties often lead to persistent challenges in reading comprehension and written communication, which may negatively affect academic achievement and learners' self-confidence.

Globally, dyslexia is estimated to affect approximately 5–17% of school-aged children (Shaywitz, 2020). Children with dyslexia frequently experience difficulties related to phonological processing, visual perception, and auditory discrimination, which are essential cognitive processes for reading development (Peterson, Robin, Pennington, & Bruce, 2015). In classroom contexts, these challenges often result in slower reading acquisition, limited vocabulary development, and lower academic performance compared with their peers (Snowling & Hulme, 2021). In many educational settings, particularly in developing countries, students with dyslexia often face limited access to appropriate learning support due to insufficient teacher training, inadequate instructional resources, and limited awareness of dyslexia among educators and parents.

In Indonesia, awareness and early identification of dyslexia remain relatively limited, which may hinder the implementation of effective interventions in inclusive education settings. Many students with dyslexia do not receive learning support tailored to their cognitive and linguistic needs, thereby increasing the risk of long-term academic and psychosocial difficulties (Galuschka et al., 2019). Consequently, innovative instructional strategies and digital learning tools are increasingly needed to support literacy development among children with dyslexia, particularly within inclusive educational environments.

Recent studies highlight the growing

role of educational technology in addressing learning barriers faced by students with special educational needs. Digital learning platforms, interactive applications, and adaptive learning technologies can provide personalized instruction and create engaging learning experiences for students with diverse cognitive profiles (Rao, Gravel, Rose, & Tucker-Smith, 2023; Al-Azawei & Serenelli, 2021). In particular, game-based learning environments have been shown to improve student engagement, motivation, and persistence in learning tasks by integrating interactive features such as challenges, rewards, and feedback mechanisms (Plass, Mayer, & Homer, 2020).

For children with dyslexia, technology-based interventions are most effective when they incorporate multisensory learning principles. Multisensory instruction engages multiple sensory channels—visual, auditory, and kinesthetic—to strengthen the neural connections involved in reading acquisition (Birsh & Carreker, 2018). Research indicates that combining phonological training with multisensory instructional approaches can significantly enhance letter recognition, phonemic awareness, and decoding skills among students with dyslexia (Snowling & Hulme, 2021). In addition, integrating gamification elements into learning platforms can increase learners' motivation and emotional engagement, which are essential factors in sustaining learning participation among students with learning difficulties (Deterding, Dixon, Khaled, & Nacke, 2017).

Despite the growing development of digital learning technologies, several limitations remain in existing educational applications designed for children with dyslexia. Many currently available applications focus primarily on isolated reading exercises or basic letter recognition and do not sufficiently integrate multisensory learning principles with interactive game-based environments. Furthermore, some digital tools lack features that allow educators and parents to systematically monitor children's learning progress. These limitations indicate the need for more comprehensive and evidence-based digital learning platforms specifically designed to address the cognitive and motivational needs of children with dyslexia.

Several previous studies have attempted to utilize technology to support reading development among children with dyslexia. For instance, flashcard-based instructional strategies have been shown to improve letter recognition and reading accuracy among dyslexic learners (Agustina, Amaliyah, & Pavita, 2023). More recently, mobile learning applications have demonstrated positive effects on alphabet recognition and early literacy development (Fitriani & Susanti, 2025). While these studies highlight the potential of digital tools in dyslexia intervention, most focus on single-mode learning approaches and do not fully integrate multisensory instruction, gamification elements, and systematic progress monitoring within a unified digital platform.

Addressing these limitations, the present study introduces *LexiPlay*, a multisensory game-based learning platform designed to support literacy development among children with dyslexia. The platform integrates visual, auditory, and interactive learning activities with gamification features to create engaging reading experiences tailored to the cognitive characteristics of dyslexic learners. In addition, *LexiPlay* is designed not only as a learning tool for students but also as a monitoring platform that enables teachers and parents to track children's reading progress.

Therefore, this study aims to develop and validate *LexiPlay*, a multisensory game-based learning platform designed to (1) support literacy development among children with dyslexia, (2) enhance learning motivation through interactive and engaging digital activities, and (3) provide a practical digital tool that assists teachers and parents in facilitating and monitoring reading progress in both school and home learning environments. By integrating multisensory instructional principles with gamified digital learning environments, this study contributes to the growing body of research on technology-supported interventions for dyslexia and offers practical implications for the development of inclusive digital learning tools within the Indonesian educational context.

METHOD

This study employed a Research and Development (R&D) design aimed at developing and evaluating an educational application called *LexiPlay*, which functions as a digital learning platform to support literacy development among children with dyslexia. The development procedure adopted the Borg and Gall development model, which is widely used in educational research to design, validate, and evaluate instructional products through systematic stages of development and testing (Borg & Gall, 2003). This model was selected because it provides a comprehensive framework that integrates needs analysis, product development, validation, and iterative revisions. Compared with other instructional design models such as ADDIE, Dick and Carey, or Design-Based Research, the Borg and Gall model allows a structured process of prototype testing and improvement, making it suitable for developing educational media intended for specific learner needs.

The original Borg and Gall model consists of ten development stages. However, in this study the procedure was simplified into seven stages to accommodate the scope and time constraints of the research, which focused on early-stage prototype development. Similar simplifications have been recommended in limited-scale developmental research (Emzir, 2017). The stages omitted from the original model include large-scale field testing, operational product revision, and dissemination, as the present study focused primarily on prototype feasibility and practicality testing. The seven stages implemented in this research included: (1) Needs analysis, involving the identification of the characteristics and learning difficulties of children with dyslexia; (2) Planning, including the formulation of development objectives and preparation of the development design; (3) Prototype development, involving the design and initial development of the *LexiPlay* application; (4) Expert validation, conducted to assess the feasibility of the prototype in terms of content, media design, and language; (5) Product revision, based on expert feedback and suggestions; (6) Limited field testing, conducted through individual trials and small-group trials; and (7) Final product revision,

based on findings obtained during the limited testing phase.

The overall development process of the LexiPlay prototype is illustrated in Figure 1.

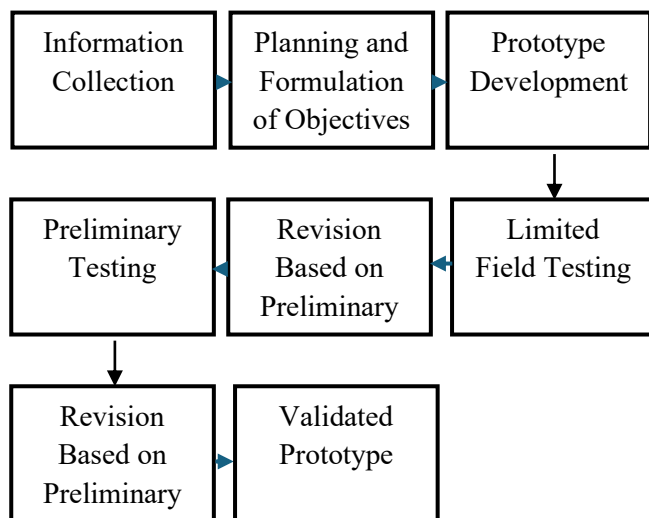


Figure 1. Research Design for Prototype Development

This research was conducted at SDN Karanganyar Gunung 02 Semarang, an elementary school that implements inclusive education practices. The research participants consisted of three elementary school students aged between 7 and 9 years who were enrolled in grades two and three and had been identified as experiencing reading difficulties consistent with dyslexia characteristics. Identification was conducted through teacher recommendations and preliminary literacy assessments indicating difficulties in letter recognition, phonological blending, and decoding skills. The inclusion criteria for participation included: (1) students experiencing early reading difficulties, (2) students without intellectual disabilities, and (3) students whose parents provided consent for participation in the study.

The relatively small number of participants was considered appropriate because the research was conducted at the preliminary testing stage of an R&D study. Early prototype testing in development research is commonly conducted with a limited number of participants to identify weaknesses in the product before broader implementation (Nieveen & Folmer, 2013).

In addition to student participants, three experts were involved in the validation process. The expert panel consisted of a

special education expert, an educational technology expert, and an elementary literacy education practitioner. These experts evaluated the LexiPlay prototype to ensure the quality and feasibility of the developed learning platform.

Data were collected using several techniques, including observation, interviews, and documentation. Classroom observations were conducted to examine students' learning characteristics and responses when interacting with the LexiPlay application. Semi-structured interviews were conducted with classroom teachers and parents to obtain information about students' reading difficulties and learning needs. Documentation was used to record student learning progress and application testing results. Data collection was conducted over a four-week period during the prototype testing phase.

Expert validation was conducted using a five-point Likert scale instrument designed to evaluate three main aspects of the prototype: content (material), media design, and language clarity. The validation results were used as the basis for revising the prototype before conducting field trials. The validity indicators used in the evaluation are presented in Table 1.

The research instruments used in this study consisted of expert validation sheets and practicality observation sheets designed to evaluate the feasibility of the LexiPlay prototype. Prior to their implementation, the instruments were developed based on theoretical frameworks related to multisensory learning, educational media design, and dyslexia literacy intervention. The indicators included in the validation instrument covered three main aspects: content relevance, media design quality, and language clarity, while the practicality instrument focused on ease of use, learning efficiency, attractiveness, and suitability for children with dyslexia.

To ensure construct validity, the instrument indicators were derived from established theoretical references in instructional media evaluation and inclusive education research. Furthermore, the instruments were reviewed by three experts in special education, educational technology, and elementary literacy education to assess the relevance, clarity, and representativeness

of each indicator. Their feedback was used to refine the wording and structure of the instrument items.

The reliability of the instrument was evaluated using internal consistency analysis, measured through Cronbach's Alpha coefficient. The reliability coefficient obtained was above the acceptable threshold of 0.70, indicating that the instrument had satisfactory reliability for research purposes (Creswell & Creswell, 2018). These procedures ensured that the instruments used in this study were both valid and reliable for assessing the feasibility and practicality of the developed learning application.

Quantitative data obtained from validation sheets and practicality observation sheets were analyzed using percentage-based descriptive statistics. The feasibility score was calculated using the following formula:

$$\text{Validity Percentage} = \frac{\text{Total Score Obtained}}{\text{Maximum Possible Score}} \times 100\%$$

The scores from the Likert scale were converted into percentages to determine the validity and practicality levels of the product. The interpretation of the validity results followed the evaluation framework proposed by (Nieveen & Folmer, 2013), which categorizes educational products based on validity, practicality, and effectiveness criteria. Meanwhile, the practicality assessment was conducted during limited field testing through observation of students' interactions with the LexiPlay application. The practicality indicators were developed based on four main aspects: ease of use, learning efficiency, attractiveness, and suitability for the learning needs of children with dyslexia, as presented in Table 2.

Table 1. Validity Assessment Indicators of the Prototype

Aspect	Indicators
Content (Material)	Alignment of content with learning objectives; Appropriateness of content to the needs of children with dyslexia; Clarity and systematic organization of content presentation; Suitability of difficulty level; Conceptual accuracy; Attractiveness of the material; Contribution of the material to literacy improvement.
Media	Visual appearance and design quality; Ease of use and navigation; Text readability; Application interactivity; Appropriateness of illustrations and audio features; Application stability and performance; Safety and child-friendly usability.
Language	Clarity of language; Appropriateness of language for the child's age level; Simplicity of sentence structure; Clarity of instructions; Accuracy of spelling and terminology; Engagement and politeness of language use.

Table 2. Practicality Assessment Indicators of the LexiPlay Prototype

Aspect	Indicators
Prototype Practicality	Ease of application use; Learning efficiency; Attractiveness and motivational value; Alignment with the needs of children with dyslexia.

To determine the level of product validity, the criteria proposed by (Akbar, 2013) were applied, as presented in Table 3.

Meanwhile, the level of product practicality was determined using criteria adapted from (Sugiyono, 2018), as shown in Table 4.

Table 3. Validity Level Categories

Percentage	Validity Category
85.1%–100%	Highly Valid
70.1%–85%	Sufficiently Valid
50.1%–70%	Less Valid
0.1%–50%	Invalid

Table 4. Practicality Level Categories

Percentage	Validity Category
82% < score ≤ 100%	Highly Practical
63% < score ≤ 81%	Practical
44% < score ≤ 62%	Less Practical
25% < score ≤ 43%	Not Practical

RESULTS AND DISCUSSION

The findings are presented in accordance with the stages of the research and development process, beginning with the initial information-gathering phase through observation and interviews concerning the reading abilities of students with dyslexia at SDN Karanganyar Gunung 02 Semarang. The information-collection step involved classroom observations, interviews with classroom teachers and parents, and a review of relevant literature concerning the learning needs of children with dyslexia. Observational findings indicated that most students with dyslexia experienced difficulties in letter recognition, phoneme discrimination, and understanding the correspondence between letters and sounds. Furthermore, conventional text-based instructional methods were found to be less engaging and tended to reduce students' learning motivation.

Interview results revealed that teachers require interactive learning media integrating visual, auditory, and game-based elements to enhance students' literacy skills. Several classroom teachers stated:

“Some students with dyslexia in my class still frequently confuse letters such as b, d, and p. They also struggle to connect letters with sounds, so when reading they tend to spell slowly and easily lose focus.”^(P1)

The teachers further emphasized the importance of interactive and enjoyable instructional media:

“Children are more interested in learning when the media includes images, sounds, and games. If they only read books, they quickly

become bored and less motivated to try reading.”^(P14)

In addition, the teachers highlighted the significance of repeated and gradual practice:

“Repeated and step-by-step practice greatly helps children with dyslexia understand letters and sounds. However, teachers are often constrained by limited time to provide individualized practice.”^(P33)

The subsequent stage involved product design and the formulation of development objectives. The LexiPlay application was designed based on the user needs analysis derived from observations, interviews, and literature on the learning characteristics of children with dyslexia. The design phase focused on developing an interactive, systematic, and user-friendly reading learning medium tailored to children with dyslexia. The instructional content primarily emphasized letter recognition, phoneme awareness, and short sentence reading. The conceptual design of the LexiPlay application is illustrated in Figure 2.

Based on the needs analysis derived from classroom observations, interviews with teachers, and a review of relevant literature, the LexiPlay application was designed as a digital learning medium to support early reading development among children with dyslexia. The design of the application focuses on providing a multisensory learning environment that integrates visual and auditory elements to help students recognize letters, understand phonemes, and practice basic reading skills. The learning activities are organized progressively, starting from

alphabet recognition, phoneme identification, and continuing to simple word and sentence reading exercises. This structured learning progression is intended to accommodate the learning characteristics of children with dyslexia who typically require repeated and gradual practice in literacy development.

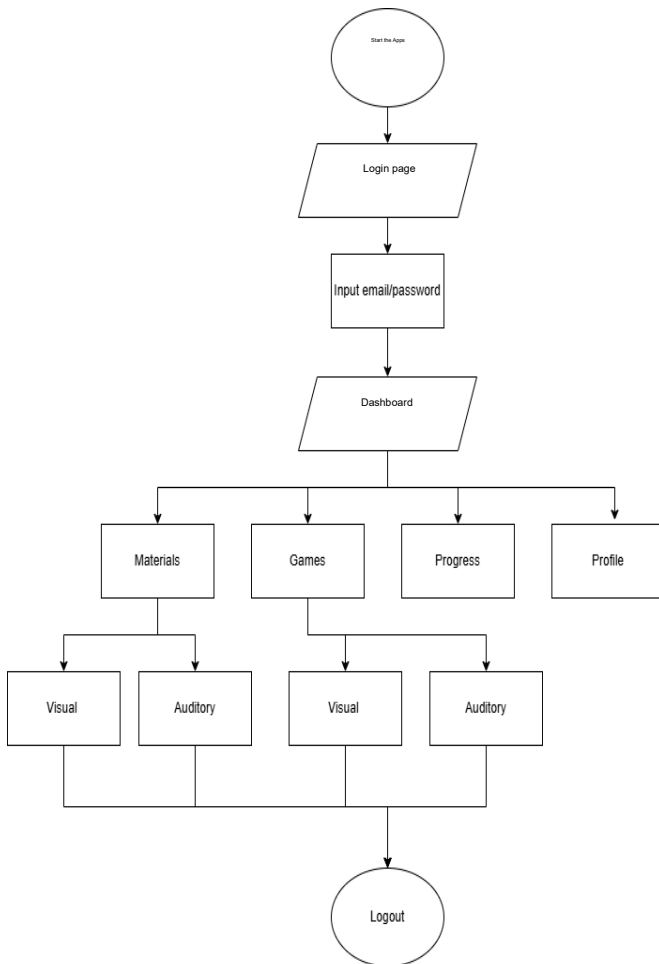


Figure 2. Program Logic Flowchart

The LexiPlay application incorporates several interactive learning features designed to support students' engagement and comprehension during reading activities. The application includes alphabet learning modules, phoneme recognition exercises, and short reading activities presented through educational games. Each learning activity combines visual illustrations with audio pronunciation to help students connect written letters with their corresponding sounds. The game-based format is intended to increase learning motivation and provide a more enjoyable learning experience for children with dyslexia.

In terms of pedagogical design, the application emphasizes multisensory learning principles by integrating visual stimuli, audio guidance, and interactive exercises within the learning activities. The interface is designed to be simple and intuitive to ensure that students can easily navigate the learning modules. The application also allows users to access different learning sections through a clear navigation system, enabling students to move between learning materials and practice activities efficiently.

Overall, the LexiPlay application was developed as a digital learning tool that combines interactive educational games with structured literacy exercises to support the foundational reading development of children with dyslexia. The design emphasizes accessibility, engagement, and multisensory learning experiences that align with the learning needs of students in inclusive educational settings.

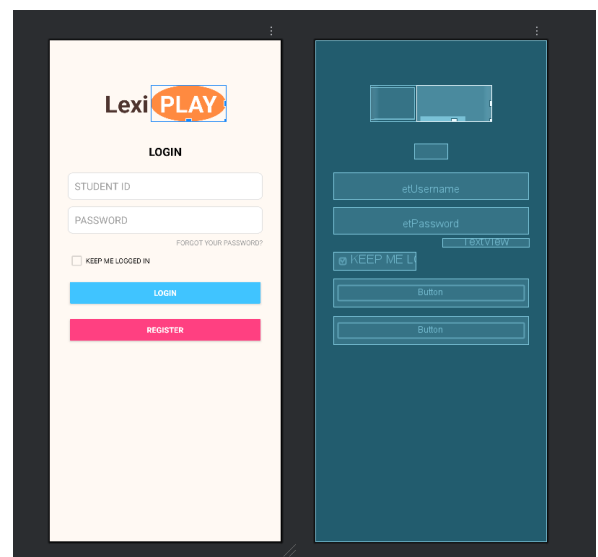
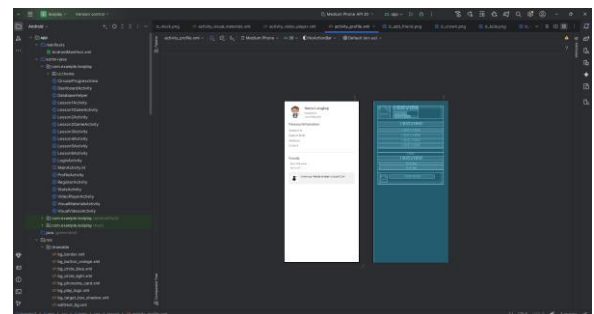
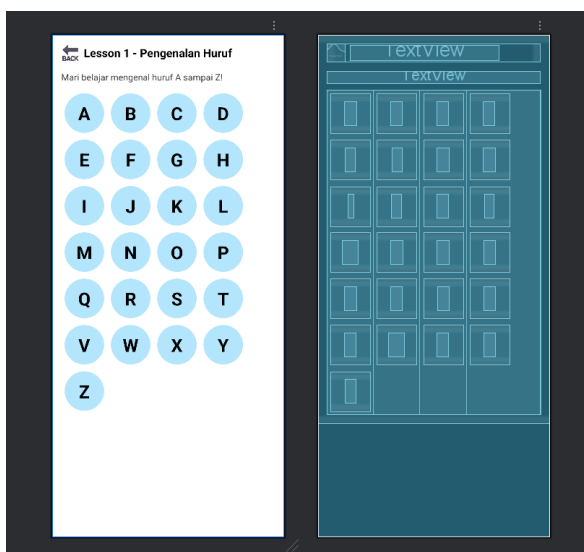
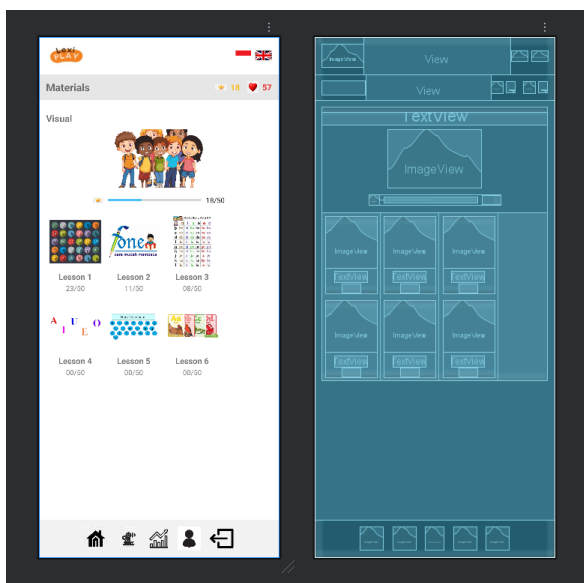
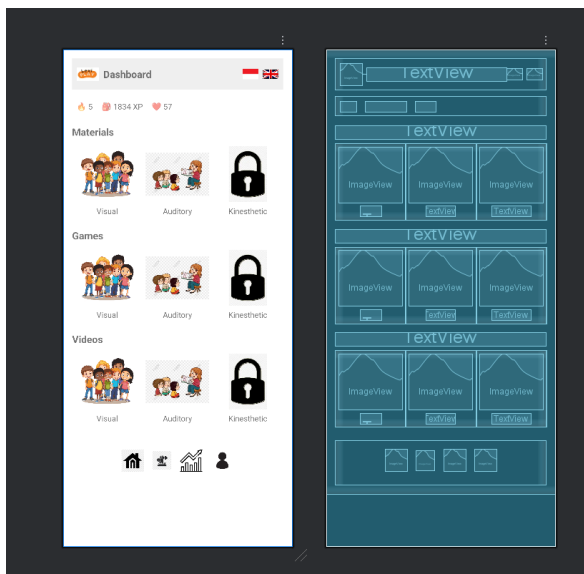


Figure 3–4. Application Development Process and Initial Display / Login Page



Figures 5–7. Dashboard Page, Materials Page, and Sample Exercise

The LexiPlay application was designed to provide an interactive learning environment that supports early reading development among children with dyslexia. The design emphasizes clear visual presentation, simple navigation, and the integration of visual and auditory elements to facilitate students' comprehension during reading activities. Learning activities are presented through interactive exercises and educational games that aim to help students recognize letters, understand phoneme–letter correspondence, and practice simple reading tasks.

The application interface incorporates visual illustrations, audio pronunciation, and simple animations to assist students in connecting written symbols with their corresponding sounds. These features are intended to support multisensory learning experiences that are considered beneficial for students with dyslexia. Figure 8 illustrates the conceptual framework underlying the development of the LexiPlay application.

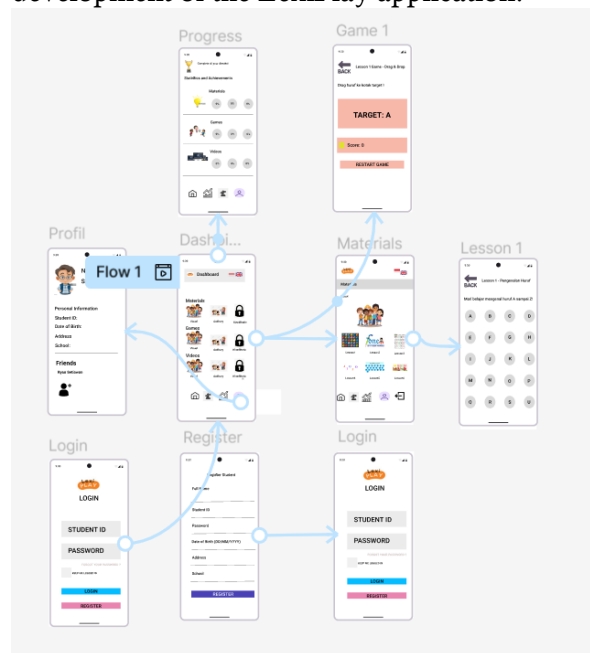


Figure 8. Conceptual Framework

The LexiPlay application was designed to provide an interactive learning environment that supports early reading development among children with dyslexia. The application integrates visual illustrations, audio pronunciation, and simple animations to help students connect written letters with their corresponding sounds. Learning activities are organized into several modules,

including alphabet recognition, phoneme identification, and simple reading exercises presented through educational games. These features aim to facilitate multisensory learning experiences that support students' engagement during reading activities.

Following the development stage, the application underwent expert validation to evaluate its suitability as a learning medium. The expert validation involved three validators, consisting of one media expert,

one content expert, and one language expert. The validation instrument consisted of eight evaluation items using a four-point Likert scale ranging from 1 (not appropriate), 2 (less appropriate), 3 (appropriate), to 4 (highly appropriate) and consisted of eight evaluation items. The maximum possible score for media and content validation was 32, while the maximum score for language validation was 24. The results of expert validation are presented in Table 5.

Table 5. Expert Validation Results

No.	Validator	Total Score	Maximum Score	Percentage	Validity Level
1	Media Expert	30	32	93.8%	Highly Valid
2	Content Expert	30	32	93.8%	Highly Valid
3	Language Expert	23	24	95.8%	Highly Valid
Average				94.5%	

Descriptive statistical analysis showed that the expert validation produced a mean validity score of $M = 27.67$ ($SD = 3.30$) across the three validators. When converted into percentages, the average validity level reached $M = 94.47\%$ ($SD = 1.15$).

These results indicate a high level of agreement among the validators regarding the feasibility of the LexiPlay application as a learning medium for children with dyslexia. The high mean percentage suggests that the application meets key quality indicators in educational media, including instructional content appropriateness, visual design clarity, and language suitability for learners with reading difficulties.

Furthermore, the relatively low standard deviation in the percentage scores indicates that the evaluations provided by the validators were consistent, suggesting a stable assessment of the application's quality across different expert perspectives. Based on the validity criteria, the LexiPlay application can therefore be categorized as highly valid and suitable for further field testing.

Following expert validation, a limited field test was conducted to evaluate the

usability and practicality of the LexiPlay application. The initial phase consisted of an individual trial involving three students diagnosed with dyslexia at SD Karanganyar Gunung 02. Usability was assessed using an instrument comprising six indicators: ease of use, clarity of instructions, interface attractiveness, effectiveness of learning activities, navigation simplicity, and overall user satisfaction.

The trial results showed scores of 20, 21, and 19 out of a maximum score of 24. Descriptive statistical analysis produced a mean score of $M = 20.00$ ($SD = 1.00$), corresponding to a practicality level of 83.3%, which falls within the highly practical category. The low standard deviation indicates consistent responses among participants, suggesting that the LexiPlay interface and learning features are generally accessible and easy to use for children with dyslexia.

Prior to usability analysis, the internal consistency of the instrument was examined using Cronbach's Alpha reliability testing. The detailed results of the individual trial and reliability analysis are presented in Tables 6-8.

Table 6. Analisis Reliabilitas Instrumen Usability

Statistic	Value
Number of Items	6
Cronbach's Alpha	0,87
Reliability Interpretation	High Reliability

The Cronbach's Alpha coefficient of 0.87 indicates a high level of internal consistency, suggesting that the usability instrument reliably measures students' perceptions of the LexiPlay application.

According to commonly accepted reliability standards, an alpha value above 0.70 is considered acceptable, while values above 0.80 indicate strong reliability.

Table 7. Descriptive Statistics of Individual Trial (n=3)

Statistic	Value
Mean (M)	20.00
Standard Deviation (SD)	1.00
Minimum Score	19
Maximum Score	21
Maximum Possible Score	24
Practicality Percentage	83,3%

Table 8. Usability Metrics per Indicator (Individual Trial) (n=3)

Usability Indicator	Mean	Standard (SD)	Deviation	Interpretation
Ease of Use	3.33	0.58		Highly Practical
Clarity of Instructions	3.33	0.58		Highly Practical
Interface Attractiveness	3.67	0.58		Highly Practical
Learning Activity Effectiveness	3.33	0.58		Highly Practical
Navigation Simplicity	3.33	0.58		Highly Practical
User Satisfaction	3.33	0.58		Highly Practical

The results of the individual trial show that the overall usability score reached $M = 20.00$ ($SD = 1.00$), corresponding to a practicality level of 83.3%. The low standard deviation suggests that the students' responses were relatively consistent across the six usability indicators.

Following the limited individual trial stage, the study proceeded to a small-group trial involving 10 students who demonstrated similar characteristics of reading difficulties. This phase aimed to further evaluate the usability and practicality of the LexiPlay application in a broader learning context compared to the individual testing stage.

During this stage, students interacted with the LexiPlay application as part of reading learning activities and subsequently

provided evaluations using the usability instrument developed for the study. Descriptive statistical analysis indicated that the scores ranged from 19 to 22 out of a maximum score of 24, with an average score of $M = 20.50$ ($SD = 1.08$). This result corresponds to a practicality level of 85.4%, which falls within the highly practical category.

The relatively low standard deviation suggests consistent responses among participants, indicating that the LexiPlay application provides a user-friendly interface and learning features that effectively support reading learning activities for children with dyslexia. The detailed results of the small-group trial are presented in Tables 9 and 10.

Table 9. Descriptive Statistics of Small-Group Trial Results (n=10)

Statistic	Value
Mean (M)	20.50
Standard Deviation (SD)	1.08
Minimum Score	19
Maximum Score	22
Maximum Possible Score	24
Practicality Percentage	85,4%

Table 10. Usability Metrics per Indicator (Small-Group Trial Results) (n=10)

Usability Indicator	Mean	Standard (SD)	Deviation	Interpretation
Ease of Use	3.40	0.52		Highly Practical
Clarity of Instructions	3.30	0.48		Highly Practical
Interface Attractiveness	3.50	0.53		Highly Practical
Learning Activity Effectiveness	3.40	0.52		Highly Practical
Navigation Simplicity	3.30	0.48		Highly Practical
User Satisfaction	3.40	0.52		Highly Practical

The descriptive statistical results demonstrate that the LexiPlay application achieved high usability performance during both the individual and small-group testing stages. The increase in the mean score from $M = 20.00$ in the individual trial to $M = 20.50$ in the small-group trial indicates improved interaction as students became more familiar with the application interface.

Furthermore, the low standard deviation values ($SD = 1.00$ and $SD = 1.08$) indicate relatively low variability among participants, suggesting consistent usability perceptions across students with different reading ability levels.

The usability indicator analysis also shows that all six indicators achieved mean scores above 3.30 on a four-point Likert scale, indicating that the application provides a user-friendly interface, clear instructions, and engaging learning activities.

Combined with the high reliability of the usability instrument (Cronbach's $\alpha = 0.87$), these results provide strong empirical support that the LexiPlay application demonstrates high levels of usability and practicality as a digital learning tool for children with dyslexia.

Discussion

The development of *LexiPlay* as an educational platform for children with dyslexia was motivated by the need for

reading instructional media that align with their cognitive characteristics and learning styles. Advances in digital technology in education have created new opportunities for interactive learning media that enhance student engagement and the effectiveness of literacy instruction. Previous studies indicate that interactive digital technologies can improve reading ability and phonological skills among children with dyslexia, as such media present learning materials simultaneously in visual, auditory, and interactive formats (Kormos & Nijakowska, 2017; Snowling & Hulme, 2021). The development of *LexiPlay* integrates multisensory learning principles, game-based learning elements, and a built-in evaluation system within a single digital platform. By combining these features, the application provides a more comprehensive and engaging learning experience compared with conventional instructional media designed for reading instruction.

The findings indicate that *LexiPlay* achieved a very high feasibility level based on expert evaluations of media, content, and language, with an average score of 94.5%. In addition, individual and small-group trials yielded feasibility levels above 80%, categorized as excellent. This high feasibility level suggests that *LexiPlay* fulfills instructional design principles appropriate for children with dyslexia, particularly in terms of

visual presentation, audio clarity, ease of navigation, and systematic sequencing of learning materials. These findings are consistent with Cognitive Load Theory, which asserts that simple and well-structured instructional design facilitates more effective information processing and reduces excessive cognitive load (Sweller, Ayres, & Kalyuga, 2019).

The observed increase in student engagement during LexiPlay use indicates that integrating game-based learning positively influences learning motivation among students with dyslexia. Students appeared more enthusiastic and active in reading activities when using the application compared with conventional methods. This finding supports prior research indicating that game-based learning enhances student engagement and motivation by presenting learning as enjoyable and challenging activities (Sailer & Homner, 2020). The educational games embedded in LexiPlay enable students to learn independently, repeat instructional content as needed, and receive immediate feedback.

Compared with previous studies, these findings reinforce the results of (Costanzo, et al., 2016), who reported that multimedia applications can improve reading abilities in children with dyslexia. Similarly, (Hall, K. Dahl-Leonard, & Thompson, 2020) demonstrated that digital technology enhances phonological skills through interactive learning. However, the present study differs from earlier research in that LexiPlay not only delivers instructional content but also integrates progressive reading exercises, educational games, and a structured progress monitoring system within a single platform. This integration represents a key innovation, as many prior reading applications primarily focus on content delivery without providing systematic learning progress tracking.

The findings also support the phonological deficit hypothesis, which posits that reading difficulties in children with dyslexia stem from weaknesses in phonological processing. Through phonological awareness exercises provided within LexiPlay, students are trained to recognize relationships between letters and sounds, thereby supporting foundational reading skill development (Snowling &

Hulme, 2021). Additionally, the multisensory approach embedded in LexiPlay aligns with multisensory learning theory, which emphasizes that reading instruction is more effective when multiple sensory modalities are engaged simultaneously. The combination of visual, auditory, and interactive elements in LexiPlay was shown to facilitate students' comprehension of learning materials more effectively (Birsh & Carreker, 2018).

From a practical standpoint, these findings suggest that LexiPlay can serve as an alternative reading instructional medium for children with dyslexia, suitable for use both in school and at home. The application can assist teachers in delivering more engaging and structured reading instruction while also enabling parents to support independent learning at home. Theoretically, this study reinforces the notion that reading instruction for children with dyslexia requires multisensory approaches, digital technology integration, and systematically sequenced instructional materials tailored to learners' abilities.

Nevertheless, this study has several limitations. The number of participants was limited to small-group trials, meaning the findings cannot yet be generalized broadly. In addition, the study did not examine the long-term effectiveness of LexiPlay in improving reading ability. The application currently focuses only on foundational reading materials and does not yet include advanced literacy skills such as reading comprehension. These limitations indicate the need for future research involving larger samples, long-term effectiveness testing, and expanded instructional features to maximize the application's potential benefits.

CONCLUSION AND SUGGESTION

This study developed LexiPlay, a game-based educational application designed to support the development of foundational reading skills among children with dyslexia. The validation results from media, content, and language experts indicate that the application meets the required feasibility standards as an educational learning medium.

Limited field testing involving individual and small-group trials also demonstrated that LexiPlay shows high usability and practicality,

suggesting that the application has strong potential as a supportive digital learning tool. The integration of multisensory learning features and educational games may help facilitate reading practice and increase student engagement. Therefore, LexiPlay can serve as an alternative digital resource to support early reading learning for children with dyslexia in inclusive educational settings.

Based on the findings and limitations of this study, several implications and directions for future research can be highlighted. The results indicate that LexiPlay demonstrates potential as a supportive digital learning tool for children with dyslexia, particularly in facilitating early reading activities through multisensory learning features. These findings contribute to the growing body of research on technology-assisted learning for students with special educational needs, especially within the context of inclusive education.

However, since this study primarily focused on evaluating the validity and practicality of the application, further research is required to examine its instructional effectiveness through experimental or quasi-experimental designs. Future studies are recommended to involve larger and more diverse samples in order to improve the generalizability of the findings. In addition, subsequent research may explore the long-term impact of the application on reading development, as well as the integration of more advanced learning features such as higher-level reading exercises, comprehension tasks, and adaptive learning analytics to support individualized learning progress for children with dyslexia.

CRedit authorship contribution statement

Menik Tetha Agustina: Conceptualization of the research idea and study design; development of the research framework and methodology; coordination of the overall research process; conducting field investigations and data collection; performing formal data analysis and interpretation; drafting the original manuscript; supervising the research activities and ensuring the quality of the study; managing project administration including research planning, implementation, and reporting.

Pratama Irwin Talenta: Software development of the LexiPlay application

including interface design and system functionality; data curation and organization of research data; validation of the developed application through technical testing and usability assessment; development of visual materials such as figures, diagrams, and application interface presentations; contributing to manuscript improvement through writing, reviewing, and editing the manuscript content.

M. Zakki Abdillah: Providing methodological support in the research design and development process; assisting in conducting field investigations and collecting supporting data; providing research resources and supporting materials related to dyslexia learning; contributing to data interpretation and discussion of findings; participating in reviewing and editing the manuscript to ensure clarity, coherence, and academic quality.

Declaration of competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The research was conducted independently, and all results presented in this study reflect the authors' objective analysis without any conflict of interest.

Declaration of the use of AI

During the preparation of this manuscript, the authors used artificial intelligence tools, including Grammarly, for proofreading and spell checking. The authors carefully reviewed and edited the generated suggestions as necessary to ensure the accuracy, clarity, and originality of the content. The authors take full responsibility for the final content of the publication.

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