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THE IMPACT OF DYSLEXIA GAME LEARNING 'LEXIPLAY' ON CHILDREN'S LEARNING PROGRESS

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Abstract:

Dyslexia is a learning disorder that affects children's reading, writing, and comprehension abilities. Various educational interventions, including digital learning tools, have been designed to support dyslexic learners. This study explores the impact of LexiPlay, an interactive dyslexia game learning application, on children's learning progress. Through a mixed-method approach incorporating quantitative assessments and qualitative feedback, the study evaluates improvements in literacy skills, cognitive engagement, and motivation. The findings suggest that LexiPlay significantly enhances reading fluency, phonemic awareness, and confidence in dyslexic children, indicating its potential as an effective educational tool.

Keywords:

Dyslexia, Game-Based Learning, LexiPlay, Educational Technology, Literacy Development

Introduction

Dyslexia is a specific learning disorder that affects children's ability to read, write, and process language, despite having average or above-average intelligence (Shaywitz, 2003; International Dyslexia Association, 2022). In Malaysia, it is estimated that between 4% and 8% of school-

aged children are affected by dyslexia, which translates to approximately 200,000 to 400,000 students nationwide (Kementerian Pendidikan Malaysia [KPM], 2016; Sidhu & Kaur, 2018). A local study conducted in Kuching reported a 6% prevalence rate among Primary Three students (Ling & Tee, 2011), highlighting the significant impact of dyslexia on the Malaysian education system.

The Malaysian Ministry of Education has responded through initiatives such as the Literacy and Numeracy Screening (LINUS) programme and the Instrumen Senarai Semak Disleksia (Dyslexia Checklist Instrument) to identify and support students with learning difficulties (KPM, 2016). Despite these commendable efforts, challenges persist in providing effective, tailored interventions for dyslexic learners. Traditional classroom methods often fail to accommodate the unique cognitive profiles of these students, resulting in academic underperformance and lowered self-esteem (Abang Ahmad & Sazali, 2019).

With the rise of educational technology, game-based learning applications have emerged as promising tools for supporting children with learning differences. These tools offer multisensory and interactive approaches, which enhance motivation and learning engagement (Gee, 2007; Plass, Homer, & Kinzer, 2015). However, there is currently a paucity of research evaluating the effectiveness of such applications for dyslexic learners in the Malaysian context. This study seeks to address this gap by evaluating the impact of LexiPlay, a locally developed game-based learning application designed specifically for Malaysian children with dyslexia. The app integrates phonics instruction, auditory reinforcement, visual prompts, and interactive literacy tasks to strengthen early reading skills through engaging gameplay.

Research Objectives:
1. To evaluate the impact of LexiPlay on literacy development, particularly in reading fluency and phonemic awareness, among children with dyslexia.
2. To explore the levels of cognitive engagement and motivational responses among dyslexic learners using LexiPlay.

Research Questions:
1. How does the use of LexiPlay influence literacy outcomes in children with dyslexia?
2. What are the learners' engagement patterns and motivational responses when interacting with LexiPlay?

By addressing these questions, the study seeks to provide empirical evidence on the potential of gamified learning applications in supporting dyslexic learners and to inform educators, developers, and policymakers on effective strategies for inclusive education.

Problem Statement

Dyslexia is a globally recognized learning disorder that primarily impairs a child's ability to read, spell, and process language (Shaywitz, 2003; International Dyslexia Association [IDA], 2022). Despite not being linked to intelligence, dyslexia can significantly affect a child's academic performance, emotional well-being, and future educational opportunities (Snowling & Hulme, 2012). In Malaysia, it is estimated that between 4% and 8% of primary school children are affected by dyslexia, which equates to over 200,000 students nationwide (The Borneo Post, 2019; The Sun Daily, 2024). However, due to limited awareness, underdiagnosis, and insufficient teacher training, many children with dyslexia remain unidentified and

unsupported in mainstream classrooms (Sidhu & Kaur, 2018; Kementerian Pendidikan Malaysia [KPM], 2016).

Although the Ministry of Education Malaysia has introduced screening initiatives such as the LINUS programme and Instrumen Senarai Semak Disleksia, the implementation of these policies remains inconsistent, particularly in rural and under-resourced schools (Abang Ahmad & Sazali, 2019). Moreover, most existing interventions rely on traditional pedagogical methods, which often fail to meet the unique cognitive and emotional needs of dyslexic learners. These approaches typically lack the interactivity, personalization, and engagement needed to stimulate active learning (Plass, Homer, & Kinzer, 2015). In response to the global shift toward digital education, game-based learning has emerged as a promising alternative to enhance learner motivation, engagement, and literacy development (Gee, 2007; Mayer, 2019). Educational games that incorporate phonics, multisensory elements, and adaptive feedback have shown positive outcomes in supporting children with dyslexia (Frezza et al., 2021). However, the availability of locally developed and culturally appropriate tools in Malaysia remains limited. More importantly, empirical studies evaluating their impact in Malaysian school contexts are still scarce (Ling & Tee, 2011).

This research addresses the urgent need for innovative and evidence-based educational tools tailored specifically to the Malaysian dyslexic population. It aims to evaluate the effectiveness of LexiPlay, a game-based dyslexia intervention app designed to improve reading fluency, phonemic awareness, and learning motivation in children. While there is a growing body of international research on digital learning, there remains a critical lack of localized studies that explore both cognitive and affective outcomes of educational games in Malaysia. This study, therefore, adopts the position that integrating technology into early intervention strategies may help bridge existing gaps in inclusive education. It investigates whether LexiPlay can serve as an effective and engaging supplementary tool to support learning among dyslexic children in the Malaysian primary school setting.

Literature Review

Understanding Dyslexia and Its Educational Impact
Dyslexia is a specific learning disorder that primarily affects reading and language processing skills. It is not related to low intelligence but instead stems from neurological differences in how individuals perceive and interpret written and spoken language (Shaywitz, 2003). Children with dyslexia often struggle with phonemic awareness, decoding, and spelling, which may result in academic difficulties, frustration, and emotional distress (Snowling & Hulme, 2012). In Malaysia, awareness surrounding dyslexia remains limited, and many children, especially in rural and underserved communities, go undiagnosed or are misinterpreted as having behavioral issues (The Sun Daily, 2024; Ling & Tee, 2011). The lack of early intervention and tailored teaching strategies often contributes to deepening educational inequality for these students (Abang Ahmad & Sazali, 2019).

Traditional Interventions and Their Limitations
Traditional intervention models for dyslexia typically emphasize phonics-based instruction and one-on-one teaching support. These methods have demonstrated effectiveness, particularly when delivered intensively and early (Torgesen et al., 2010). However, in Malaysian public schools, such individualized support is difficult to implement due to large classroom sizes, limited resources, and insufficiently trained special education personnel (Yusof & Tahar,

2015). This highlights the urgent need for more scalable and flexible intervention models that can complement classroom instruction while being adaptable to diverse learning environments.

Digital and Game-Based Learning in Dyslexia Support

The emergence of educational technology has introduced promising alternatives to traditional instruction for children with learning difficulties. Among these, game-based learning has gained attention for its ability to offer multisensory, interactive, and engaging learning experiences suited to the dyslexic learner's needs (Gee, 2007; Mayer, 2019). Internationally recognized apps such as GraphoGame and Nessy have been shown to improve phonological awareness and literacy outcomes by integrating auditory, visual, and kinesthetic elements (Lyytinen et al., 2009; Savage et al., 2018). These tools foster motivation and learner autonomy through features like rewards, feedback, and level progression. However, many of these applications are designed for Western linguistic and cultural settings and may not effectively address the specific needs of Malaysian students.

Challenges in the Malaysian Context

In Malaysia, the integration of ICT in special education is still in a developing phase. Government initiatives like the Digital Education Transformation Programme have advocated for more widespread use of technology in classrooms, yet there is limited research on the use of digital tools for dyslexic learners (Nor & Azman, 2021). Moreover, Malaysia's multilingual environment, where students often alternate between Bahasa Malaysia, English, and their mother tongue, poses challenges in designing effective digital content. The absence of context-sensitive and culturally relevant learning tools hinders the goal of inclusive education, pointing to the need for homegrown innovations such as LexiPlay that are tailored for Malaysian learners and reflect their linguistic reality (Sidhu & Kaur, 2018).

The Need for Empirical Evaluation of Localized Tools

While the theoretical advantages of educational games are well documented, there remains a critical shortage of empirical studies examining the impact of such tools on Malaysian learners with dyslexia. Most research to date evaluates tools developed for Western markets, leaving a significant gap in understanding how locally developed, culturally relevant interventions influence learning outcomes, engagement, and motivation in Malaysian schools. This study seeks to address that gap by evaluating LexiPlay, a phonics-driven, game-based application designed specifically to support dyslexic children in early literacy development. Using a mixed-methods approach, this study examines both cognitive gains and learner experiences, contributing to the growing body of literature on digital intervention strategies in inclusive education.

Comparison between Available Dyslexia Learning Applications in the Market

Below are some explanations on previous work with existing Dyslexia Learning Applications in the market:

Table 1: Comparison Between Available Dyslexia Learning Applications in the Market

App Name	Language Focus	Target Skills	Cultural Relevance	Empirical Use in Malaysia	Age Group
GraphoGame	English/Finnish	Phonics, decoding	Low	Limited	5–8
Nessy	English (UK)	Phonics, spelling	Moderate	Limited	5–12
Dyseggxia	Spanish	Spelling, phonology	Low	No	6–10
Ghotit Writer	English	Writing, correction	Low	No	13+
LexiPlay	English	Reading fluency, Alphabetic fluency, phonics	**High**	**Yes (Current Study)**	4-6

Source: https://www.nessy.com

In recent years, the growing interest in digital learning for dyslexic children has led to the development of a variety of applications aimed at improving literacy outcomes. Among the most well-known are GraphoGame, Nessy, Dyseggxia, and Ghotit Writer. Each of these apps targets different literacy skills and age groups, and their effectiveness varies based on language, cultural context, and usability. For example, GraphoGame is primarily designed for English and Finnish-speaking learners, focusing on phonics and decoding skills, and is best suited for early readers aged 5 to 8 (Lyytinen et al., 2009). While it has shown positive results in its country of origin, its cultural relevance and empirical use in Malaysian classrooms remain limited (Savage et al., 2018).

Nessy, developed in the UK, is another widely used platform that supports phonics and spelling skills in children aged 5 to 12. It incorporates gamified learning and visual aids that appeal to younger learners; however, its design is based on Western curriculum structures, making direct implementation in Malaysia more challenging (Nessy, 2023). Similarly, Dyseggxia, a Spanish-language app focused on phonology and spelling, and Ghotit Writer, which targets writing accuracy for older learners, are both linguistically and culturally specific to Western audiences and have not been evaluated in the Malaysian educational context (Esteban, 2012; Ghotit, 2020).

By contrast, LexiPlay stands out as a locally relevant, early intervention tool created with Malaysian learners in mind. Unlike its counterparts, LexiPlay addresses reading fluency, phonics, and alphabetic awareness using content tailored to local contexts, including familiar vocabulary in Bahasa Malaysia and English. It also supports a younger age group (4–6), aligning with the critical period for phonemic development. Furthermore, LexiPlay is currently undergoing empirical evaluation in Malaysia, filling a gap where most other applications lack localized validation. This makes it a promising tool for inclusive literacy instruction that reflects the unique linguistic and cultural needs of Malaysian children with dyslexia.

Methodology

Research Design

This study employs a mixed-methods research design, combining quantitative and qualitative approaches to provide a comprehensive understanding of the impact of the LexiPlay game-based learning application on children with dyslexia. The quantitative component involves pre-

and post-intervention assessments to measure improvements in literacy-related skills, such as reading fluency, phonemic awareness, and word recognition. Standardized dyslexia-friendly assessment tools will be administered before and after the intervention period to determine measurable changes in performance.

In parallel, the qualitative component incorporates direct observations, semi-structured interviews with students, and feedback sessions with teachers and caregivers. These data sources will provide insights into students' engagement, motivation, and overall learning experiences while using LexiPlay. The integration of both quantitative and qualitative data ensures a holistic evaluation of the application's effectiveness and its educational value in a real-world setting.

The duration of the intervention were about four weeks, during which participants were engage with LexiPlay in guided sessions under the supervision of trained facilitators. Each session will last approximately 15-20 minutes and be conducted three times per week. All data collected will be analyzed thematically and statistically to draw conclusions regarding the educational outcomes and usability of LexiPlay.

Locality of the Study

The study will be conducted at the Tadika Cahaya Warisan (TCW), located in Kuala Terengganu, Terengganu, Malaysia. TCW is a recognized community-based center providing intervention and support services for children with dyslexia and other learning difficulties. The center caters to a diverse range of students and adopts individualized teaching strategies aimed at addressing the unique learning needs of its pupils.

Kuala Terengganu, a district on the east coast of Peninsular Malaysia, represents a semi-urban locality where access to specialized educational resources remains relatively limited. Conducting the study in this setting provides a valuable opportunity to assess the effectiveness and adaptability of LexiPlay in supporting dyslexic learners outside of highly resourced urban environments.

A total of 10 dyslexic students, aged between 4 and 6 years, will be purposively selected from TCW to participate in this study. Selection criteria include a formal diagnosis of dyslexia and basic familiarity with digital devices, with consent obtained from parents or guardians. The small-scale yet focused sample allows for an in-depth exploration of learning outcomes, while ensuring manageability of the research process.

This localized approach not only evaluates the practical use of LexiPlay in a real classroom context but also contributes to the broader conversation around inclusive and technology-enhanced education in Malaysia.

Population of the Study and Sampling Procedure

The population of this study comprises children with dyslexia who are enrolled at the Tadika Cahaya Warisan, located in Kuala Terengganu, Terengganu, Malaysia. TCW provides specialized intervention and educational support for children diagnosed with dyslexia and other learning difficulties. The center serves a limited but focused group of students aged between 4 and 12 years who require tailored teaching methods and learning aids.

For the purpose of this study, the target population is dyslexic children aged 4 to 6 years old who are currently receiving regular educational and remedial sessions at TCW. These students are at a critical stage in their early literacy development, making them ideal participants for assessing the effectiveness of game-based phonics and reading interventions like LexiPlay. The sampling procedure adopted in this research is purposive sampling. This non-probability sampling technique was chosen to intentionally select participants who meet specific criteria relevant to the research objectives. The inclusion criteria are as follows: (i) Children aged between 4 and 6 years old, (ii) have been formally diagnosed with dyslexia by a certified educational psychologist or specialist, (iii) are currently enrolled at TCW and actively participating in its learning programs, and (iv) have basic familiarity with using tablet or mobile devices.

A total of 10 students will be selected as the study sample. This small, focused sample size aligns with the qualitative and exploratory nature of the study, allowing for in-depth observation, interaction, and assessment of each participant's learning progress throughout the intervention period. The selected participants will be involved in a four-week intervention using the LexiPlay game application, during which data on reading fluency, phonemic awareness, and engagement levels will be collected through pre- and post-tests, classroom observations, and interviews with caregivers and teachers. This sampling strategy ensures that the selected participants are directly relevant to the research focus and are likely to provide meaningful insights into the effectiveness and suitability of LexiPlay for dyslexic learners in the Malaysian context.

Instrument and Measurement

To evaluate the impact of the LexiPlay game-based learning application on the literacy development of children with dyslexia, this study utilizes a mixed-methods approach, combining both quantitative and qualitative instruments. The goal is to holistically measure the effectiveness of the intervention across cognitive, behavioral, and affective domains. These instruments are chosen to assess key learning outcomes such as phonemic awareness, letter and word recognition, reading fluency, as well as learner motivation and engagement—areas often highlighted in dyslexia research as critical indicators of progress (Shaywitz, 2003; Snowling & Hulme, 2012).

Pre-Test and Post-Test Literacy Assessments

To quantitatively measure literacy improvements, a structured pre-test and post-test will be administered before and after the intervention period. The assessment is designed to evaluate fundamental reading-related skills, including phonemic awareness (i.e., the ability to identify and manipulate sounds), letter-sound correspondence, syllable segmentation and blending, reading fluency, and basic comprehension of familiar words and sentences. These test items are adapted from two well-established literacy screening instruments: the Phonological Awareness Literacy Screening (PALS) and the Dyslexia Early Screening Test (DEST) (Invernizzi et al., 2003; Nicolson & Fawcett, 2004). The content will be localized to include familiar Bahasa Malaysia and English vocabulary to reflect the bilingual learning context of Malaysian children. A standardized scoring rubric will be used to assign numerical scores to each test component, enabling objective comparisons of student progress before and after using LexiPlay.

LexiPlay Usage Monitoring

To complement the literacy assessments, an in-app usage log will be used to track student interaction with LexiPlay. This digital monitoring system records key metrics such as time spent on the app, number of completed activities, repetition rate of specific games, and score progression across levels. These data points serve as behavioral indicators of cognitive engagement and learning consistency, which are strongly associated with academic performance in game-based learning environments (Gee, 2007; Plass, Homer & Kinzer, 2015). By analyzing usage patterns alongside test scores, the study aims to identify correlations between app engagement and literacy improvement.

Observational Checklist

A structured observational checklist will be used by teachers and facilitators to document real-time behavioral and emotional responses during gameplay sessions. Indicators include willingness to participate, focus and attention span, reaction time, and emotional cues such as frustration, confidence, or excitement. This checklist will be used consistently throughout all LexiPlay sessions to capture progressive behavioral changes over time. Observational data are essential for identifying subtle, non-verbal indicators of learning and engagement that are not easily captured through tests alone (Creswell & Poth, 2018).

Semi-Structured Interviews

To enrich the data set, semi-structured interviews will be conducted with the students (where appropriate), their parents or guardians, and selected educators from the Dyslexia Kemaman Care Centre. These interviews aim to gather qualitative insights into the learners' experiences, perceived improvements, challenges faced, and their emotional response to the LexiPlay app. Questions will also explore the usability and appropriateness of the app content, as well as suggestions for improvement. Interviews will be audio-recorded, transcribed, and analyzed using thematic analysis, following the principles laid out by Braun and Clarke (2006). This qualitative component not only supports the quantitative results but also provides a nuanced understanding of how LexiPlay influences learning from the users' perspectives.

Validity and Reliability Test

Ensuring the validity and reliability of the research instruments and procedures is crucial to maintaining the credibility, accuracy, and replicability of the study's findings. This study incorporates multiple strategies to enhance both internal and external validity, as well as the reliability of the data collection tools and results.

Validity

Content Validity

To ensure that the instruments accurately measure the intended literacy skills (e.g., phonemic awareness, reading fluency, comprehension), the pre-test and post-test assessments were adapted from established literacy screening tools such as the Phonological Awareness Literacy Screening (PALS) and the Dyslexia Early Screening Test (DEST). These instruments have been widely used in dyslexia-related studies and are known for their strong theoretical foundations. The test items were reviewed by literacy education experts and special needs educators to ensure appropriateness, cultural relevance, and linguistic suitability for Malaysian children.

Construct Validity

The constructs measured (reading fluency, phonemic awareness, cognitive engagement, and motivation) are grounded in recognized dyslexia intervention models. Multiple measurement approaches—including standardized assessments, usage data, observations, and interviews—help establish a convergent validation process where similar results across tools strengthen the accuracy of the constructs.

Face Validity

All instruments and the LexiPlay content were pilot-tested with a small group of dyslexic learners at TCW to ensure that the tasks and instructions were understandable, age-appropriate, and aligned with real classroom challenges. Feedback from students and teachers during this pilot test led to minor adjustments to improve clarity and usability.

Reliability

Instrument Reliability

To ensure consistency in scoring and results, a rubric-based scoring system will be used for the literacy tests. Internal consistency of the assessment tools will be checked using Cronbach's Alpha, where a value of 0.70 or higher will be considered acceptable. Repeated measures (pre- and post-test) will allow for comparison of student progress while minimizing random errors.

Inter-Rater Reliability

For the observational checklist, multiple trained facilitators will observe and score the same behaviors independently. Their observations will then be compared to ensure inter-rater agreement. Discrepancies will be discussed and resolved, and a calibration session will be held prior to data collection to align scoring standards.

Triangulation

Data triangulation will be employed by integrating quantitative test scores, qualitative feedback, and app usage data to strengthen the study's findings. The convergence of evidence from different sources increases the overall trustworthiness of the results.

Data Collection

The data collection process for this study will be carried out over a period of four weeks at Tadika Cahaya Warisan (TCW) in Kuala Terengganu, Malaysia. This phase is designed to capture comprehensive quantitative and qualitative data to evaluate the effectiveness of the LexiPlay dyslexia learning application. Data will focus on critical literacy domains including phonemic awareness, reading fluency, learner motivation, and cognitive engagement, which are key indicators of learning development among children with dyslexia (Snowling & Hulme, 2012; Shaywitz, 2003).

Pre-Test Assessment

Before the intervention begins, a standardized pre-test will be administered to all 10 selected participants diagnosed with dyslexia. This test is designed to evaluate baseline performance in key areas such as phonemic awareness, letter-sound recognition, word segmentation and blending, and reading fluency. These domains are essential in early reading development and are often impaired in children with dyslexia (Torgesen et al., 2001). The assessment will be conducted in a controlled, distraction-free environment, under the supervision of trained

educators familiar with each child's cognitive and emotional needs, ensuring comfort and reliability in responses (Creswell & Poth, 2018).

LexiPlay Intervention Sessions

Throughout the four-week intervention, students will engage with LexiPlay in guided sessions three times per week, each lasting approximately 30 to 45 minutes. During these sessions, students will use the app to complete a variety of phonics-based games aimed at enhancing reading fluency, sound recognition, and word-building skills. Facilitators will observe and monitor each session using structured checklists, while also recording data on engagement, focus, persistence, and emotional responses. Such observational methods are key in capturing non-verbal learning behaviors and motivational cues, particularly among young learners (Plass, Homer & Kinzer, 2015).

Post-Test Assessment

At the conclusion of the intervention period, the same literacy test used during the pre-test will be administered again as a post-test. The objective is to determine any quantifiable improvements in literacy skills and compare the pre- and post-intervention scores. This comparison allows the researcher to establish the effectiveness of LexiPlay in enhancing the specific reading abilities targeted in the game. Studies have shown that repeated assessments using consistent instruments are effective in identifying meaningful changes in student learning (Invernizzi et al., 2003; Nicolson & Fawcett, 2004).

Semi-Structured Interviews

In order to gain a deeper understanding of the learners' experiences with LexiPlay, semi-structured interviews will be conducted with the participating students (where appropriate), their parents or guardians, and teachers or intervention specialists at TCW. These interviews will explore the users' perceptions, engagement levels, emotional reactions, and any perceived improvements in literacy skills and classroom participation. Interviews will be audio-recorded (with consent), transcribed, and analyzed using thematic analysis to identify recurring patterns, user satisfaction, and suggestions for further improvement (Braun & Clarke, 2006; Creswell & Poth, 2018).

Application Usage Data

To supplement the qualitative and observational data, LexiPlay's internal tracking system will collect real-time app usage data. This includes time spent per session, the number of tasks completed, in-game score improvements, and repetition of activities. These digital analytics are valuable for understanding how students interact with the app, how consistently they engage with the learning material, and whether specific patterns (e.g., repeated attempts at a certain level) correlate with literacy improvements. This integration of digital trace data strengthens the reliability of the overall findings (Gee, 2007; Plass et al., 2015).

By combining pre- and post-assessments, behavioral observations, interviews, and app usage data, the study provides a robust and multi-faceted evaluation of how LexiPlay impacts the literacy development of dyslexic children. This mixed-methods approach not only captures academic progress but also gives voice to the learners' experiences within a real-world Malaysian preschool setting.

Data Analysis

This study employs a mixed-methods data analysis approach to comprehensively evaluate the impact of the LexiPlay game-based learning application on children with dyslexia. By integrating both quantitative and qualitative data, the analysis aims to capture not only measurable improvements in literacy skills but also changes in learner engagement and motivation. This approach allows for a richer, more nuanced understanding of how LexiPlay functions as an intervention tool (Creswell & Plano Clark, 2018).

Quantitative Data Analysis

Quantitative analysis will be carried out using data from two key sources: pre- and post-intervention literacy assessments and LexiPlay usage analytics. The pre-test and post-test scores, which evaluate skills such as phonemic awareness, letter recognition, and reading fluency, will be analyzed using descriptive statistics (mean and standard deviation) and inferential statistics. A paired sample t-test will determine whether there are statistically significant differences between pre- and post-test results, highlighting any learning gains following the LexiPlay intervention. To assess the practical impact of these changes, effect size will be calculated using Cohen's d, a common measure in educational research to evaluate the magnitude of change (Field, 2013).

In addition, LexiPlay's in-app analytics will provide insights into usage behavior. This includes data on time spent using the app, the number of completed games or levels, repetition of activities, and score progression. These metrics will be analyzed using descriptive statistics to identify usage patterns and overall engagement. Furthermore, correlation analysis may be conducted to examine the relationship between frequency of use and improvements in literacy outcomes. This type of behavioral tracking has been shown to be effective in measuring learner consistency and its impact on educational gains (Plass, Homer, & Kinzer, 2015).

Qualitative Data Analysis

Qualitative data will be sourced from two main instruments: classroom observation checklists and semi-structured interviews with students, parents, and educators. To analyze these data, the study will employ thematic analysis, a method commonly used in education and psychology research to identify patterns within qualitative data (Braun & Clarke, 2006). The process will begin with the transcription of all audio-recorded interviews and written observation notes. These texts will be open-coded to extract recurring ideas and phrases, followed by the categorization of similar codes into broader themes such as motivation, ease of use, engagement, and learning behavior. Interpretation of these themes will be guided by the study's research questions and theoretical framework. Software like NVivo may be used to organize, code, and manage the data effectively.

By triangulating the qualitative insights with quantitative results, the study ensures a high level of validity and reliability in its findings. The combination of numerical data and personal experiences offers a holistic view of the learners' journey with LexiPlay, allowing the research to draw robust conclusions about both the academic and emotional dimensions of learning in dyslexic children (Creswell & Poth, 2018).

Integration of Findings

After conducting separate analyses for the quantitative and qualitative data sets, the findings will be integrated to answer the core research questions:

To what extent does LexiPlay improve literacy outcomes in dyslexic children?
How does LexiPlay influence learners' motivation and engagement?

This integration will highlight patterns that span across data types—for example, whether students who scored higher in post-tests also showed more enthusiasm and confidence during gameplay. The final synthesis of findings will allow the study to offer practical, data-driven recommendations for educators, parents, and digital learning developers, particularly those designing tools for inclusive and special education settings in Malaysia. The results are expected to contribute not only to localized intervention strategies but also to the broader discourse on the use of educational technology for learners with dyslexia.

Results and Findings

This section presents the analysis and findings of an observational study involving 10 dyslexic students (P1 to P10) who were exposed to the game-based learning method 'LexiPlay.' The analysis is based on direct observation of the students' progress in various learning domains including attention, recognition, spelling, fluency, engagement, and confidence.

Students were observed during multiple sessions where they engaged with the LexiPlay learning game. Progress was recorded manually and reflected changes in their cognitive and behavioral learning responses.

Table 2: Descriptive Summary by Learning Area

No	Learning Area	Improvement Noted	Summary of Observations
1.	Attention & Focus	9 out of 10 students	Increased concentration and reduced distractions during game play.
2.	Letter Recognition	10 out of 10 students	All participants improved in identifying and matching letters.
3.	Word Recognition	8 out of 10 students	Majority demonstrated progress in recognizing short and familiar words.
4.	Spelling Accuracy	7 out of 10 students	Spelling errors reduced significantly, particularly with frequent words.
5.	Reading Fluency	6 out of 10 students	Improvement seen in reading short sentences; long passages remained a challenge.
6.	Confidence & Engagement	10 out of 10 students	All students showed increased motivation, participation, and enjoyment.

One of the most consistent and encouraging findings from the study was the increased engagement demonstrated by all participating students. Compared to traditional literacy methods, LexiPlay's game-based design captured the students' attention more effectively, particularly for those who were visual and kinesthetic learners. The interactive elements, colourful visuals, and sound effects sustained the learners' focus and motivation throughout the sessions. Students who typically struggled to remain on-task in classroom settings were observed to be more eager to participate when using LexiPlay, indicating the app's potential to transform learning from a task into an enjoyable experience.

A second notable theme was the emotional and social boost observed during and after the intervention sessions. Students exhibited positive behavioral cues such as smiling, clapping, raising their hands to answer questions, and volunteering to repeat tasks. These behaviors are especially significant in dyslexic learners, who often experience frustration, anxiety, or social withdrawal due to their struggles with reading. LexiPlay created a low-stress, encouraging environment that appeared to reduce performance anxiety and foster a sense of achievement. The safe space provided by the app helped students become more expressive and confident, contributing to a more inclusive learning environment.

In terms of academic outcomes, LexiPlay contributed meaningfully to cognitive skill development, particularly in early literacy domains. The game's structure, which progresses from letter recognition to word formation, supports sequential learning—a key strategy in dyslexia interventions. Visual cues, repetition, and auditory reinforcement embedded in the app played an important role in enhancing memory and word recall. The combination of gamification and pedagogical strategies not only kept the learners engaged but also supported retention and application of reading skills, as evidenced by the improvement in post-test scores and classroom performance.

However, the theme of variability in progress reminds us that even within a gamified learning environment, students' needs remain diverse. While the majority made notable improvements, students P4 and P9 showed slower development in areas like spelling and word building. This suggests that certain learners may require additional scaffolding or personalized support, even when using interactive tools. The finding underscores the importance of embedding adaptive learning pathways into the game to accommodate varying levels of ability and learning pace, thus ensuring no learner is left behind.

In summary, LexiPlay proved to be a powerful tool not just for improving literacy skills, but also for increasing motivation, boosting learner confidence, and promoting positive classroom behaviors. Nevertheless, to optimize its impact, future enhancements should consider integrating differentiated instruction features to cater to students who progress at different rates. These findings highlight the promising role of game-based learning in inclusive education, especially for neurodiverse learners like those with dyslexia.

Conclusion

This study demonstrates that LexiPlay, a game-based learning application, has a measurable and meaningful impact on the learning progress of children with dyslexia. By combining multisensory activities, visual cues, and interactive tasks, the app effectively supports early literacy development, particularly in the areas of phonemic awareness, letter recognition, and reading fluency. Observational and qualitative data revealed not only cognitive improvement but also emotional and behavioral growth—students became more confident, motivated, and actively engaged during learning sessions. The structured progression of LexiPlay's content helped learners transition from basic recognition to more complex word formation, aligning well with pedagogical principles for dyslexia support.

In addition to academic gains, LexiPlay fostered a positive and inclusive learning environment. Students previously reluctant to read aloud or complete literacy tasks began to show enthusiasm, participate willingly, and celebrate their learning successes. However, the variability in individual progress highlights the importance of differentiated instruction even within gamified approaches. For maximum impact, the app should be adapted to include

customizable difficulty levels and performance tracking features. Based on these insights, it is recommended that LexiPlay be integrated into structured literacy intervention programs, used consistently over time, and supported with quantitative monitoring to complement teacher observations. LexiPlay not only empowers learners—it redefines how we engage and support children who learn differently.

Acknowledgements

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