MOBILE LEARNING APPLICATION FOR STUDENT AT RISK OF DYSGRAPHIA: A SINGLE CASE STUDY

Ni Made Yuniari[1)], and Ni Luh Gede Karang Widiastuti [2)]

[1),2)] Dwijendra University, Denpasar, Indonesia
yuniari6868@gmail.com

ABSTRACT

Academic writing skills are essential for students and are developed from an early age; however, conditions like dysgraphia can hinder learning, impacting writing abilities and social relationships, which in turn affects mental health. These disabilities often lead to low self-esteem, anxiety, and frustration, ultimately influencing the quality of education received. The advent of technology in education has introduced mobile learning applications that cater to diverse learner needs, providing immediate responses and feedback while allowing students to learn at their own pace. This study aims to explore how m-learning technologies can assist students with writing disabilities through a single case involving a child, parent, and teacher. Data collection methods include direct observations, interviews, and pre- and post-intervention questionnaires, focusing on various analysis categories such as perceptions of teachers and parents, user satisfaction, student behavior, and the effectiveness of the technology used. The findings indicate that the "Marbel Menulis" mobile learning application significantly improved the writing skills of a student with dysgraphia, being described as user-friendly, enjoyable, and effective in enhancing writing abilities. The app's interactive features kept the student engaged and reduced resistance to writing tasks, while parental involvement was found to be crucial for the app's success. The study suggests that further research is needed to assess the long-term effects of such interventions. In conclusion, the "Marbel Menulis" application not only enhances writing skills but also boosts motivation and confidence among students at risk for dysgraphia, highlighting the importance of engaging content, parental involvement, and thoughtful application design in educational technology.

Keywords: dysgraphia, handwriting, learning disabilities, mobile learning application, writing skill

1. INTRODUCTION

Gaining knowledge is not only equal to reading and writing but also the other important skills. Teaching and learning through writing, as well as reading, starts right from an early age (Sihwi et al., 2019). First and effective methods of teaching writing as well as handwritten work are crucial for the development of reading skills. As highlighted by Barrett et al. (2020) this acquisition is crucial for future academic achievement. The skills of writing are important for school because, as noted in the work of Nurchaerani et al. (2022), the pupils need to be able to express ideas in written form and use new information to modify the existing knowledge. Furthermore, learners with writing disabilities can also face problems as well in their academic achievement. There are cases where teachers reduce the knowledge acquisition of their students due to their learning disabilities and they assume that their students are idle in writing (Sihwi et al., 2019).

Learning disabilities are a significant impediment to a large number of students who come across them in their studies (Molina-Vargas et al., 2021). Apart from the low

academic achievements, they are faced with other massive challenges in their behaviors and social lives (Atanga et al., 2020). These learning disorders include dysgraphia, autism, and dyslexia among others. According to Gouraguine et al. (2023), dysgraphia is among the learning disability that is seen often in learning institution. It influences its performance in school, coordination and even state of mind. Furthermore, students with dysgraphia have writing difficulty in terms of the rate, clarity of writing, spelling, grammar, writing, and organization and many more (Chung & Patel, 2015). According to Chung et al. (2020) dysgraphia is a form of dyslexia which is defined as a special character disability. Some of these are: poor formation or neatness of letters, irregular space between letters, proper use of capital and small letters, ability to control and co-ordinate movements in writing, writing speed and standard of correct English in writing both in essays and notes. Additionally. This disorder has the potential to impact not only student's academic process, but also significant aspects of a life cycle. Such children are more likely to show odd or negative feelings, worry more and have been reported to have low self-esteem and higher risk of dropping out early from school ((Chung et al., 2020; Feder & Majnemer, 2007). There are three distinct forms of dysgraphia: CC Dyslexic Dysgraphia, Motor Dysgraphia and Spatial Dysgraphia Dyslexia Dysgraphia Motor Dysgraphia Spatial Dysgraphia (Gkeka & Drigas, 2022). Dysgraphia is defined in learners when they should have been having appropriate handwriting in their second year of elementary learning. However, dysgraphia is barely measurable in children below that age and so, the child with the poorest chance of survival in today's world (Lomurno et al., 2023). Therefore, to avoid such results in learning, work and other activities in each client's daily life it is vital to select the right type of intervention.

Treatment for language-based learning impairments using conventional methods often involves lengthy and costly procedures. Due to the lack of access to healthcare in their rural or suburban areas, many children remain untreated (Bhatt, 2020). Utilizing digital technologies can help with assistance, training, and learning facilitation. Using specially designed apps that catch their attention can help students with disabilities succeed in traditional classroom settings and integrate more easily (Williams et al., 2006). Moreover, educational tools may provide relief for youngsters who struggle with dysgraphia. There are many options for kids with dysgraphia to learn through their distinctive talents, particularly with mobile apps (Hopcan & Tokel, 2022). Mobile applications may be beneficial for those who have dysgraphia, a type of learning disability that hinders a person when it comes to writing. With children who have surface dyslexia, semantic dyslexia, dysgraphia, or dyscalculia these applications will assist them in support and remedial manner. Besides, integration of advanced technologies like using laptop, tablets, and smart phones in teaching and making learning process easier and faster fall under mobile technology in education. Thus, the technologies which grant the students the access to the large amount of the educational materials have transformed the characteristics of the learning process as well as facilitated and enhanced the learning processes through the learning environment (Criollo-C et al., 2021). Modern students can find easy and free instructional content, engaging tools, and even individual learning opportunities on mobile education applications intended to improve the learning experience. All these applications can be used by students in learning and also in the involvement of the students on the various mobile devices (Criollo-C et al., 2021).

Numerous earlier studies have been conducted on mobile applications that help kids with learning impairments. Bhatt (2020) conducts the first study. It focuses on using Android Studio and Apache Cordova to create a mobile application. Children with surface dyslexia, semantic dyslexia, dysgraphia, and dyscalculia are the target audience for this program. The program must plan to create an acceptable environment of learning favorable to children and more preferred if it is going to use the things that create sense among them. In the second strand, Hopcan & Tokel (2022) investigate the possibility of enhancing dysgraphia pupils' handwriting using a writing application installed in a smartphone. Another study conducted was by

Drigas & Angelidakis (2017), who reviewed scholarship findings on mobile applications for dyslexia identification and treatment. Most of these apps are developed to address various dyslexia symptoms such as writing difficulties. 'Helply' is a brand new portable device which was introduced in recent research study done by Muthumal et al. (2022). To assist youngsters diagnosed with dyslexia in their reading ability and improve their color recognition and short-term memory, this program incorporates a robotic mode. Moreover, Madeiraa et al. (2015) explore the adoption of apps designed for dyslexia and present a corresponding app which was trialed with Portuguese students and is designed for the Portuguese language.

In Indonesia, there are several mobile applications that are designed and developed to support the handwriting skills of students. Those applications can be downloaded on the App Store and Play Store freely. However, Mobile applications provided by the app store and play store are still very limited, especially mobile applications that use Indonesian as a language of introduction. Besides, the applications available in Indonesia are not intended for children with dysgraphia. One of mobile learning application that can be download on Play Store is MarBel Menulis. It is an educational app designed to facilitate children's acquisition of writing skills for letters and numbers. It is specifically tailored for children between the ages of 5 and 8. Nevertheless, the aim of this study is to examine the efficacy and influence of a mobile learning application specifically developed for a student who is at risk of dysgraphia. The aim of the study is more precise and focuses on understanding the student's perspective on the use of the application, as well as their interest level. It also tries to find out the challenges faced by the student while using the applications and assess whether the application has a positive impact on the confidence level of the student to write. Moreover, the elaborated research proposes to explore the parents' and teachers' perceptions of children concerning the effectiveness of the mobile learning application. This will give a broad view of its 'Pros' and 'Cons' in an aspiration to help students at risk of dysgraphia. In essence, the study aims at finding out how students with writing difficulties can be helped through mobile learning technologies based on a single case study.

2. RESEARCH METODOLOGY

Research Design

This study employs a qualitative research methodology focused on a single-case design. A single-case design is a research design that focuses on studying a single individual or entity in-depth (Bhattacherjee, 2012). This design will focus on one particular student at risk of dysgraphia. A baseline assessment of the student's abilities before the introduction of the mobile learning application would be documented. Following this, the intervention with the mobile learning application would be applied, and changes in the student's performance would be observed and recorded over time. The research could implement pre- and post-intervention assessments to measure the impact of the mobile application on the student's dysgraphia symptoms.

The Participants

The description of the participating persons is as follows:
P1 - an 8-year-old girl. She was the first child of a family. She attended a private school in Bali. She was currently in the second grade of elementary school. At the age of 2, she exhibited a speech delay. She was subsequently referred to a pediatrician, who recommended occupational and speech therapy. At the age of 3, her parents enrolled her in a preschool to facilitate socialization with her peers. However, due to the global pandemic, this child was only able to attend school for a single semester. Consequently, the educational institution was forced to close, and learning was conducted remotely. After two years, the child was able to resume his studies as the incidence of Covid-19 infections began to decline. Over time, he has

made progress in developing his speech, although her communication skills remain below the level expected for his age.
P2 – Mother of the girl. She was a lecturer and a housewife. She was employed at a private university in Bali. She had two children, a girl and a boy. She was the first to suspect that her daughter had difficulty writing.
P3 – teacher of the girl. She is a teacher at a private elementary school in Bali. She teaches second grade students. She has been teaching for more than 20 years.

Data Collection
As part of the overall study and to have an assessment of how effective the application is and how well it has modified the learning experience of the student, the data would be collected from various approaches. Objective data would be collected in the form of observation and written documentation while non-numerical data would be obtained from interviews concerning images and feedback that cannot be measured. While qualitative data would be assessed through interview, quantitative data would be attained through pre- and post-intervention assessments or tests to establish the extent of improvement on specific competency areas such as handwriting. Further, clinical observations such as note-taking and photo documentation of the student's activity and response while the active usage of the mobile application at home. Last, the approach of document analysis would be based on gathering data of the student's writing prior and after applying the application for revealing improved handwriting techniques.

Data Analysis
As a result of data gathering several methods would be used to help in achievement of the objective of understanding the experience of the student in the use of the mobile learning application. Content analysis of interviews, structured along the experiential use, derived benefits, and perceived hurdles, would be conducted using qualitative content analysis method (Elo & Kyngäs, 2008). Frequency distributions and other quantitative measures would be described, and shifts in performance would be explained (Creswell & Creswell, 2017). Self-generated products, such as narratives and note-taking, would be assessed in terms of sight to illustrate patterns or trends of the student writing and learning after the intervention. Last but not least, a case study narrative would use both qualitative and quantitative data in a story format, describing the student's broad experience with the application.

3. LITERATUR REVIEW

Learning Disabilities
The ability or inability to learn under certain conditions is called learning disability. These are also referred to as specific learning disorders or learning disabilities. Such a disorder might influence how an individual gathers, organizes, stores, interprets, or applies oral or nonverbal information. Individuals who struggle with learning disabilities frequently experience persistent issues with particular skills, like language, math, reading, and writing (Al-Mahrezi et al., 2016). One kind of learning disability is specific learning disabilities (SLDs). They entail issues with understanding written or spoken language (Kohli et al., 2018). Separate learning disorders that become apparent during childhood are referred to as developmental disorders and include lifetime learning disabilities concerning reading as well as writing, in addition to mathematics. Seven categories of learning disorders have been recognized by the Learning disorders Association of America: visual perceptual deficiency, auditory processing disorder, NLD; Dyslexia, Dysgraphia, Dyscalculia and Auditory processing disorder. Disruptions of this kind may be necessitated by environmental, neurological, or hereditary causes. It might be experienced by learners with normal or even higher ability, they can also receive special lessons and assistance on how to manage learning disabilities (Muktamath et al., 2021)

Dysgraphia

Dysgraphia is one of the learning disorders that is frequently observed in the educational sector, according to Gouraguine et al. (2023). It has a substantial impact on the person's motor abilities, mental health, and academic achievement. Furthermore, dysgraphia sufferers have difficulty with all facets of writing, including composition, spelling, speed, legibility, and grammar (Chung & Patel, 2015). Chung et al. (2020) define dysgraphia as a disorder marked by specific traits. Along with a general deficiency in written communication skills, these include issues with letter formation or legibility, letter spacing, orthography, fine motor coordination, writing speed, grammar, and composition (Crouch & Jakubecy, 2007). This is hence why identifying dysgraphia in teaching environment involves interventions, which aim at touching these areas of difficulty and offering the necessary assistance to the child with dysgraphia in order to enhance academic success (Moreau & Waldie, 2016). In children, dysgraphia affects motor skills, mental health and learning abilities, and therefore, learners diagnosed with it should receive specific supports and interventions at school to allow them learn with ease and excel (Gargot et al., 2021)

Mobile Application for Learning Disabilities

The advancement of ICT provided children with learning disability with better support (Ariffin et al., 2018; Pee et al., 2014; Zain et al., 2013). This is because learning disability youngsters connect with it in a rewarding way and enjoy an aesthetically pleasing environment bolstered by images and sound. According to Drigas & Angelidakis (2017), mobile applications provide a mobile learning environment that facilitates student interaction, enables quick access to a range of web material, and takes into account individual student learning styles. These tools provide the learner with the ability to practice multiple times and can adjust to their own speed (Akbayrak et al., 2021; Kagohara et al., 2013). ICT has played a big role in teaching and learning by enhancing learning through making it easy for children with learning disabilities to learn as compared to before. Not only do they find them more appealing visually, but since mobile applications and other gadgets as well as other digital tools are more interactive and adaptive to the learning process, it can easily accommodate the learning style of the students (Bagon & Vodopivec, 2016). In addition, it is possible to note that these tools do not impose a strict number of repetition attempts and allow students to practice at one’s own tempo, thus making the use of such tools more inclusive overall and efficient for learning.

Figure 1. Dwijendra University (Center justified, Arial 8pt)
Source: Dwijendra University (Center justified, Arial 8pt)

Illustration of figures and tables must be compressed to the level of print output target (220ppi) so that the file sent is not too large.

4. RESULTS AND DISCUSSION

RESULT

There are several categories emerged from the data: (1) teacher and parental observations; (2) usability and user experience; (3) student's behavioral and emotional responses; (4) instructional content and strategies; (5) technological integration and support; (6) effectiveness of the mobile learning application (7) challenges and barriers'

Teacher and Parental Observations

Teacher Observation at school

As reported by the child's teacher at school before the student given treatment using mobile learning application, the child exhibited signs of writing difficulties during the middle of the first semester. When confronted with a writing task, the child would often remain silent and refrain from completing the assignment: "What I observed was that this child often stayed silent and did not do the work. Sometimes she would do the writing task, sometimes not. If she wanted to write, she didn't finish the assignment. Only half done. But when she was in a good mood, she finished her work. But it takes a long time to finish." (P3) On occasion, she would complete the writing task, but often did not do so unless she was in a positive mood. The process, however, was lengthy. The child displays emotional cues such as crying in response to reprimands or when the teacher's tone is perceived as harsh. Consequently, the teacher is reluctant to reprimand the child, as this may result in emotional distress. When it comes to writing assignments, the child behaves very differently from other activities. For example, in cultural arts classes, he shows a lot of passion when asked to draw: "Yes, she has a different attitude during cultural arts lessons." (P3) If this child is kindly asked to draw, then she will be very happy. It is worse when asked to write, she looks so lazy as if asking her to write was too much for her. If it is required that this child reads something, then she is still better, she can read properly. " (P3) Furthermore, the child seemed to have good reading skills. In response to feedback or corrections on his writing tasks, the child exhibited a lack of emotional response, regardless of the perceived value of the task. This writing difficulty does not appear to have an adverse effect on the child's social relationships with his peers in the classroom. The child continues to engage in social interactions with her peers, and her interactions with them appear to be positive. However, the child's interaction with the teacher is infrequent: "This child seems to have good interaction with his classmates. He rarely wants to talk to me." (P3) The teacher has taken steps to assist the child in overcoming his writing difficulties by consistently encouraging him and asking his classmates to encourage him to write. Despite none of the mentioned intervention having been followed with a view of attending to the emotional aspect of the child while writing, the teacher has spoken to the child's mother when picking the child and explained to her or requested her help in practicing writing with the child at home. In simple, it means that to this date no information sharing had been made with specialists or counselors for this child.

Parental observation at home

Variability is discernible in relation to the child's interactions with the app. There was also a sense that during the first thirty minutes the child's writing was the main activity. However, after this period, the folk focus often reduced because of young siblings' interference or other factors in the environment. It may be due to distractions around her, such as being bullied by his younger sibling or being invited to play by his younger sibling: : "The first 30 minutes he focuses on practicing writing, then the next minute he starts to lose focus." (P2). Nevertheless, child generally demonstrated greater excitement and motivation when learning to write with the app compared to other learning methods. The child occasionally completes the tasks assigned by the app, but there are instances when she abandons the task before reaching completion: "Sometimes the activities are completed, sometimes the activities are still halfway done." (P2). Parent observed an improvement in their

child's writing skills since using the app. The child's writing became neater, with fewer instances of ups and downs, crossing lines, and reversed letters. Additionally, the child exhibited increased confidence in writing, as evidenced by his calm demeanor and lack of inquiries regarding the correctness of his writing: “Yes, more confident. From her reaction, not questioning much on the correctness of her writing, I could tell right from her body language that she was completely recovered.” (P2) These observations indicate that the application has a beneficial effect on child’s handwriting skills. Thus, one can conclude that both the support that parents provide and their presence are crucial when employing the specified app. The parent was consistently present with the child throughout the app usage, providing guidance and assistance, particularly when the child encountered advertisements or other obstacles: “When an advert comes up on the screen, I have to teach her how to go past it, I co-direct her when using the app for instance when there is an advert on the screen, I tell her how to avoid it.” (P2) In this app there was tool bar on top of the screen which had a tab called track progress. However, to get this feature, users must purchase the full version of this app: “Yes there is such feature in the app; ‘track progress’ that is how I track my child’s progress.” (P2) Tracking progress was also used in order to make sure that any challenge that a child comes across is overcome. During the use of this application, this child appeared to be emotionally satisfied, and there was no impact of anger. It is also observed that children appeared to be more interested when they were learning with the help of the app as opposed to learning activities, this can be adjudged from the pictures below. It was stress-free to the child meaning that not only is the app effective, but also it is enjoyable to use: “I noticed no difficulty or confusion on the part of the child in the use of the app.” (P2) In addition, it may be noted that there were no technical problems experienced. When faced with challenges or difficulties, children typically seek assistance from their parents: “My child usually asks me questions and asks me for help.” (P2) These interviews prove that writing of apps is beneficial for child’s writing in terms of both skill and motivation regardless of the few shortcomings regarding focus and use frequency. Parents’ support also reflect their roles in the proper usage of the app in the care of their children.

Usability and User Experience

As for usability, parent reported that her child was able to convenient learn how to use the “Marbel Menulis” app. There was no observed problem in the usual operations of the app, which shows that the child had easy time going through the interface of the app. Parents also stated that their child found the app to be an easy-to-use tool, with no features or functionality that were confusing or difficult for the child to understand: “My child finds the app easy to use. My child did not feel at all confused in using this app.” (P2) To the question of how to improve the app, the parent just answered none which of course implies that the current setting of the app is good enough in a certain way. On the user experience aspect, child found the “Marbel Menulis” application engaging and fun to use. The app effectively motivates children to learn to write, providing them with a sense of accomplishment throughout the learning process: “Yes, as a result of using this app my child was motivated to learn to write.” (P2) None of the features or aspects of the app was considered as being uninteresting or unpleasant by the parent. This overall positive reaction implies that the app is beneficial for children not only in the informational aspect but is entertaining and effectively motivates children to use the app for learning. Based on the interview results, it can be concluded that the proposed “Marbel Menulis” app is quite easy to use and brings positive learning experience. Children want to learn and become engaged in the process of using this app to learn how to write. The high appreciation by the users and the lack of recommendations during a parent’s feedback represent the effectiveness and the fun experience using “Marbel Menulis” in teaching children who are at a risk of developing dysgraphia.

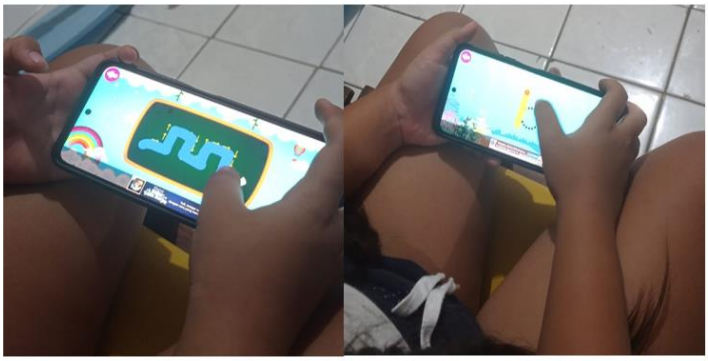

Figure 2. Child's experiences in using "Marbel Menulis" App

Student's Behavioral and Emotional Responses

Parent of student was using the "Marbel Menulis" app. The interviews revealed that parents reported their child's enthusiasm and focus when using the app, but some noted that the child sometimes felt bored if the app was used for too long: This implies that while practicing with the app, child's resistance towards writing reduced: "My child does not appear forced when required to write after using this app." (P2) With the app, child did not exhibit negative behaviors like aggressiveness or anger while writing and seem to focus on the task: "My child seems enthusiastic and quite focused when practicing writing with this app. But if it takes long, sometimes boredom sets in." (P2) Regarding emotions, child was reported to be enthusiasm and happiness while using the app and she was seen to be anxious or frustrated. Parent also indicated that no feelings of sadness or anger were elicited while using the application. One major shift that was noted was that child was not grumpy or felt compelled to write, which could be a testimony of the new found comfort while writing. From the analysis of the features of the "Marbel Menulis" it can be stated that it appeared to help to raise children's desire to develop writing skills. Parent reported that her child was more motivated and interested in writing after using the app, and she also showed increased confidence in her writing skills: "Yes, she feels more confident in her writing." (P2) There are also opinions from parents regarding the need to develop motivation of application: "Maybe add more game features." (P2)

In conclusion, based on the findings on the interviews it can be deduced that the "Marbel Menulis" application is effective in influencing children's behavior and feeling towards writing as well as their motivation to write. The app makes children feel more at ease and encouraged to write plus, it enhances positive attitudes towards one's writing skills. These interviews offer a clear understanding of costs and benefits of the "Marbel Menulis" app, that is separate for each child, according to the parents' observations. Consistent with the earlier impressions, parents estimated that on average their child employs the application about three times a week, nonetheless this is random and depends on the mood of the child. Users claim that children prefer to use the application at night when they are unwinding. Initially, the child makes numerous uses of the app but as days and weeks go by, the app loses its applicability in his or her everyday life.

Instructional Content and Strategies

In the interview, the parent provided a positive evaluation of the learning app utilized by her child. She deemed the learning materials in the app to be appropriate for her child's needs and to encompass the various aspects of writing skills required: "I think the material in this app is suitable for my child's needs. Because my child is trained to write from the basics through this application." (P2) According to her, the materials presented are suitable for her child's level of development and ability. Parent also indicated that the teaching methods employed in the app are highly effective in facilitating their child's comprehension and mastery of writing skills. The app is perceived as interactive and engaging, offering helpful explanations and guidance for their children. Furthermore, parent indicated that the app can adjust the material

and difficulty level based on their child's ability and progress: While the app lacks specific features for children at risk of dysgraphia: “This application does not seem to have such a feature.” (P2) This application is considered flexible as it does not have a time limit for the exercises. In terms of feedback, parent indicated that the app provides positive reinforcement when tasks are completed correctly, which motivates their child. The feedback provided was deemed specific and constructive enough to help her child understand her mistakes and correct them: “What I saw were words of praise when I got it right and also when I finished practicing writing.” (P2) The activities and exercises provided in the app were also considered diverse and challenging, thus encouraging her child to engage with the material: “Yes, she felt challenged and wanted to try until she could.” (P2) All the exercises in the app were considered effective in helping her child improve his writing skills. Parent integrated the use of the app into their child's daily learning routine by having the child write in a book first and then practicing again using the app to correct mistakes: “I do integration by asking children to write in a book first, when there are wrong writings or letters, I ask them to practice again using the writing marble application.” (P2) The app is considered an effective tool for reinforcing or complementing the learning her child receives at school, with minimal difficulty in integrating it with other learning methods.

Figure 3. Features in the “Marbel Menulis” application

When it comes to the use of technology applications for children, the findings of the interview showed that child was cohesively knowledgeable about the application installation process and deemed it similar to installation of other applications. As it is presented, the app performs its operation on the smartphone device employed without any support from other devices like the stylus or keyboard. With regard to the connection and the synchronization with the data, the app works under this aspect and there was no problem in the network connection as well as in the synchronization. Nevertheless, parent had not yet fiddle with the app in an offline mode since the device is always connected to the internet. The child’s data and learning progression was also safeguarded well and the information was retrievable through the “track activity” option on different apparatus.

Technological Integration and Support

In terms of technical support, parent had never encountered technical issues and had not found adequate technical support within the app, with the exception of the feedback menu and email contact for complaints: “As for the complaints they are free to send their complaints to an email support center evidently available in the app.” (P2) It had a help center in the form an email to report their complaints if they have any. Regarding security and privacy, the app was considered highly secure, as all activities require parental guidance, and system settings could only be accessed by parents: “It is very safe since all activities require some supervision from parents, the setting system could be opened only by parents.” (P2) Parent was comfortable with the information requested and stored in the app as well as sufficient options related to parental control was available in the setting menu. In terms of updates and maintenance, parent had not updated the app, but had added paid features for use: “I have never synced this app, I have only added premium features, So that the feature can be utilized.” (P2) The app update for the application was not an issue. Another thing as far as the developers are concerned is that they were also seen to

be accommodating users' input and recommendations. However, the application did not have some functions that were useful for linking with other learning applications or systems being adopted by a child within a learning environment. However, the show played an important role in either supporting or extending children's learning in context other than school. Resourcefully, the application was not designed for use at a class, or in cooperation with teachers and fellow students.

Effectiveness of the Mobile Learning Application

The following is the results of that interview. The parent provided insights on the use of the app "Marbel Menulis." Despite not having been formally diagnosed with dysgraphia, the child exhibits symptoms indicative of writing difficulties: "My child has never been diagnosed with dysgraphia. But from the symptoms and characteristics of her writing, my daughter might have dysgraphia." (P2) The child had been utilizing the app for a period of two months, with a frequency of three times a week: "My child has only been using this app for two months. Every week it is used three times." (P2) The parent indicated that she found the app appealing due to its vibrant animations and endearing animal characters. Additionally, she appreciated its user-friendly interface, which did not require the use of additional tools. However, she expressed reservations about certain paid features and the frequent advertisements that appeared when they did not purchase the full version of the app: "Some features are paid and ads often appear if you don't buy the full version." (P2) When queried about the efficacy of the app, parents indicated that it assisted their child in developing writing skills. The app employed a progressive approach, initially focusing on fundamental skills such as line thickness, before progressing to more advanced features. After two months of use, parents observed a notable improvement in their child's writing abilities. Their child's writing became more legible and no longer exhibited erratic alignment. In addition, parents noted that the child's writing was untidy before, and letters and numbers were written in the wrong orientation. Some of the letters were also inverted often. However, after using the app, the child's writing became neater, with letters and numbers consistently aligned within the line, and letters of the same size: "More so, there was improvement on the appearance of learnt letters when writing separately in words, compared to previous habits of being messy and out of line as noted below, "My child's writing looks neat and is in order unlike before where it was very messy."(P2) Such findings in a way do tally with the findings of the post-test and the understanding of the child handwriting shows differences between and pre-test and the post-test stages. The materiality of writing reflects changes in the quality of the child's writing, there is a clear progression away from slope and such undesired writing attitudes as the use of overwriting, large letters, interruption of the baseline. The following are handwritings of the child, before and after using the "Marbel Menulis" app.

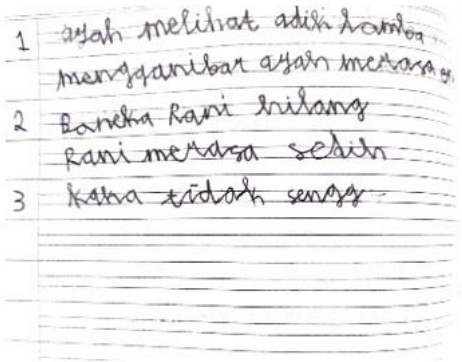

Figure 4. The handwriting of the child before using "Marbel Menulis" app

Figure 5. The handwriting of the child after using “Marbel Menulis” app

In addition to this, on the other Parent observed positive change in several other aspects. Another said that although her child had no problem with grip of pencil, they observed that their child was starting to write in the manner the app had instructed. Additionally, the child's ability to write in a neat and organized manner improved, as did their fluency and coherence in writing: “Before, when I did not use this app, my daughter wrote in a certain way certain letters which was different from the normal way of writing. She had her own writing style. Now my child knows how to write in the correct way that he learned on the features in this app.” (P2) Besides, she noted that the child had become more confident in writing, not lazy, but more interested in the writing exercises. According to the parent, the “Marbel Menulis” app was very effective in enhancing correct writing in the child. She also advised the same application to other parents of the children with tendencies of developing dysgraphia. She recommended that useful features should be included to increase children’s passion for writing such as a street writing feature.

Challenges and Barriers

The results of the interview conducted in this study are as follows in terms of its findings on challenges Barriers associated with the ‘Marbel Menulis’ application. The problem took place when the child started to use the app, and during that time, she did not face any difficulties. In the case of the two apps, specific features lacked any form of ambiguity or confusion, and they were as follows. Their child was capable of independently utilizing the application and parent was not obligated to pay special attention to the process. Regarding the technological aspect, the child had no problems with the application’s operating system, that is, there were no crashes, lags, or other annoying bugs. The use of the app furthermore did not encounter any technical problems that may have affected the child and her motivation to participate in using the app, and therefore, no technical support from the application was needed. From the extracts gathered from the parent, the two concerning devices and the internet was established to have not posed a challenge on them. The child has proper and maximum utilization of the app. This means that; there was no time constraint in any sense, since the said app offers a timing feature, which parents may set to suit their child’s needs. Although the app appeared to be a game, there were instances when the child becomes disinterested and unmotivated, particularly if they are engaged in practice for an extended period: “She usually gets bored if she practices for too long,” there are also times when he already gets bored although it is in the form of a game. To address this, parent provide a snack as a form of reward after the child completes an activity in the app: “If she completes an activity on this app, I give her a snack.” (P2) Still, this app could not be compared to another app

with functional features that could help to regain the child's focus. Concisely, learning through the app was viewed as being quite good, with only a few factors hindering the benefit of this innovation. Even such insignificant obstacles could be easily addressed to make sure that learning stays efficient.

RESULT

This case focus and analyses exploration of the "Marbel Menulis" mobile application for the purpose of ascertaining its effectiveness in boosting the writing skills of a student who is predisposed to dysgraphia. Thus, this discussion will compare the findings of the study with relevant literature, consider the implications to educational practice. Some of the findings that arose as a result of the post and the study conducted on "Marbel Menulis" application are as follows. For this aspect the student showcased a lot of improvement in the writing style and neatly written letters and spaces. This corresponds to the findings of earlier studies explaining that by frequently using mobile applications, children with dysgraphia may be able to improve their writing since the exercises included in the apps are repeated several times and feedback is provided immediately (Gargot et al., 2021; Gouraguine et al., 2023). Secondly, one was motivation and confidence in writing tasks which was demonstrated by the student. The originality was also not an issue since the student managed to sustain the interest and minimize the amount of resistance in the application use influenced by the interactive elements of the application. In this regard, this study is in line with other studies that have discussed on the motivational aspect of the mobile learning tools on the learners with learning disabilities, (Drigas & Angelidakis, 2017; Hopcan & Tokel, 2022). Third, the study highlighted the importance of parents in the maximized use of the app, based on the findings obtained. Parents decided on the spots and directions which can be noteworthy in addressing the issues like distractions and ensuring on-target child attention. This is in agreement with prior body of evidence pointing that parent involvement is essential for translating educational interventions form an aspiration to a reality for children with LD (Williams et al., 2006). Last but not the least, it was appreciated that the application under consideration was easy to use and did not confuse a child: the interface was quite clear. Ease of use is crucial here to keep the child interested and to practice repetitively, as stated earlier in the afforested study on proactive design of education apps for kids having a disability (Fernández-López et al., 2013).

The conclusion made in this research corresponds to several theoretical works and prior studies on the effectiveness of utilizing MLAs for children with dysgraphia and other learning challenges. This means the following, all of which are in line with the proposition of assistive technology theory. Consequently, the use of mobile applications can help in the provision of differentiated learning that meets the unique needs of learners with learning disorders. Such technologies can thus help in improving learning outcomes since the materials which are being provided to learners are both adaptive and interactive in nature (Bagon & Vodopivec, 2016; Kagohara et al., 2013). The rise in motivation and self-confidence evident from the students can be understood from self-determination theory which stipulates that motivation in students is determined by autonomy, competence, and relatedness. Self-directing learning proposed by the app and constant tips encouraging the learner are in tune with this theory by Ryan & Deci (2000). The paper also supports other learning theories such as the constructivist learning theory in form of involving students in a learning process. The options that are linked with the app's interaction and the chance for the student to perform an important writing task are considered constructive in line with the theoretical positions specified by Vygotsky & Cole (1978). The positive results in this study have several points of application to education practices. Mobile learning applications can be used to help schools and teachers to educate the students who have dysgraphia, it is recommended that the strategies be employed. Such tools can help in providing extra help and targeted practice time for any students who need it. Concerning the use of educational apps, parents should be encouraged to engage in the process since this would improve on the preparations. As such, schools should undertake to offer training and or materials

that would help parents support their children's learning activities in a home environment. Based on the findings, it is suggested that future educational apps' developers focus on the development of easy to navigate, attractive and differentiated tools meeting the needs of learners with LD. Some of the elements, which can further increase the usability of the application, are as follows: the availability of feedback; the use of bonuses, such as encouragement; and the presence of adjustable levels of difficulty.

Therefore, the study provides insights into the possibility enhancement of the effectiveness of mobile learning applications in the education of students with dysgraphia difficulties. In various ways, the interactions, the engaging and fun aspects, the involvement of parents, and the easy access to the writing blog have a strong correlation towards bettering the students' writing and their motivation. These findings are coherent with prior works and theory on assistive technology, self-determination, and constructivism. The implications of this type of intervention on the academic achievement of learners with LD should be the focus of the future research studies In addition more research should be conducted on the sustainability of such approaches and the generality of the findings to a more diverse sample of learners with LD.

5. CONCLUSION

Thus, in one single-case study, it can be claimed that the effectiveness of using the mobile learning application called "Marbel Menulis" is extremely high when it comes to improving the students at risk of dysgraphia. The element of fun, together with the stimulating features of the app in question has been shown to enhance the student's prose, as well as their enthusiasm and confidence. This follows the layout of the application as it has been verified to be fungible due to its ability to maintain the student engaged and also minimize or eradicate resistance towards completion of writing assignments. The practice of parents also plays a crucial role for the achievement of practice because it provides guidance and support to overcome the hurdles and to stay on the course with the software. Due to its basic layout, it is possible to encourage people to remain engaged and constantly use the application for practicing. These findings correlate with other researches on the use of mobile learning applications for children with dysgraphia and other learning disabilities. Future research has been called for to explore the long term effects of these therapies and its appropriateness for other learners with learning disability. The focus should be made to create apps for education that are special, fun, and rather functional to deal with the needs of children with dysgraphia and other learning difficulties.

REFERENCE

Akbayrak, K., Vural, G., & Ağar, M. (2021). The Experiences and Views of Special Education Teachers Towards Distance Education Throughout Coronavirus Pandemic Period. *Inonu University Journal of the Faculty of Education (INUJFE)*, *22*(1).

Al-Mahrezi, A., Al-Futaisi, A., & Al-Mamari, W. (2016). Learning Disabilities: Opportunities and challenges in Oman. *Sultan Qaboos University Medical Journal*, *16*(2), e129-31. https://doi.org/10.18295/squmj.2016.16.02.001

Ariffin, M., Othman, T., Aziz, N., Mehat, M., & Arshad, N. (2018). Dysgraphi coach: Mobile application for dysgraphia children in Malaysia. *International Journal of Engineering and Technology(UAE)*, *7*, 440–443. https://doi.org/10.14419/ijet.v7i4.36.23912

Atanga, C., Jones, B. A., Krueger, L. E., & Lu, S. (2020). Teachers of students with learning disabilities: Assistive technology knowledge, perceptions, interests, and barriers. *Journal of Special Education Technology*, *35*(4), 236–248.

Bagon, S., & Vodopivec, J. L. (2016). Motivation for using ICT and pupils with learning difficulties. *International Journal of Emerging Technologies in*

Learning, *11*(10). https://doi.org/https://doi.org/10.3991/ijet.v11i10.5786 S.
Barrett, F. S., Doss, M. K., Sepeda, N. D., Pekar, J. J., & Griffiths, R. R. (2020). Emotions and brain function are altered up to one month after a single high dose of psilocybin. *Scientific Reports*, *10*(1), 2214. https://doi.org/10.1038/s41598-020-59282-y
Bhatt, P. (2020). Mobile application for dysgraphia, surface dyslexia, semantic dyslexia and dyscalculia. *Journal of Emerging Technologies and Innovative Research (JETIR)*, *7*(12), 813–815. https://api.semanticscholar.org/CorpusID:235483939
Chung, P., & Patel, D. R. (2015). Dysgraphia. *International Journal of Child and Adolescent Health*, *8*(1), 27.
Chung, P., Patel, D. R., & Nizami, I. (2020). Disorder of written expression and dysgraphia: definition, diagnosis, and management. *Translational Pediatrics*, *9*(Suppl 1), S46–S54. https://doi.org/10.21037/tp.2019.11.01
Criollo-C, S., Guerrero-Arias, A., Jaramillo-Alcázar, Á., & Luján-Mora, S. (2021). Mobile learning technologies for education: Benefits and pending issues. *Applied Sciences*, *11*(9), 4111. https://doi.org/https://doi.org/10.3390/app11094111
Crouch, A. L., & Jakubecy, J. J. (2007). Dysgraphia: How it affects a student's performance and what can be done about It. *Teaching Exceptional Children Plus*, *3*(3), 1–13.
Drigas, A., & Angelidakis, P. (2017). Mobile Applications within Education: An Overview of Application Paradigms in Specific Categories. *Int. J. Interact. Mob. Technol.*, *11*, 17–29. https://doi.org/https://doi.org/10.3991/ijim.v11i4.6589 Athanasios
Feder, K. P., & Majnemer, A. (2007). Handwriting development, competency, and intervention. *Developmental Medicine & Child Neurology*, *49*(4), 312–317. https://doi.org/https://doi.org/10.1111/j.1469-8749.2007.00312.x
Fernández-López, Á., Rodríguez-Fórtiz, M. J., Rodríguez-Almendros, M. L., & Martínez-Segura, M. J. (2013). Mobile learning technology based on iOS devices to support students with special education needs. *Computers & Education*, *61*, 77–90. https://doi.org/http://dx.doi.org/10.1016/j.compedu.2012.09.014
Gargot, T., Asselborn, T., Zammouri, I., Brunelle, J., Johal, W., Dillenbourg, P., Archambault, D., Chetouani, M., Cohen, D., & Anzalone, S. M. (2021). "It is not the robot who Learns, it is me." Treating severe dysgraphia using child–robot interaction. *Frontiers in Psychiatry*, *12*, 1–11. https://doi.org/10.3389/fpsyt.2021.596055
Gkeka, E., & Drigas, A. (2022). Ict's and dysgraphia. *Technium Social Sciences Journal*, *31*, 228–240. https://techniumscience.com/index.php/socialsciences/article/view/6423
Gouraguine, S., Riad, M., Qbadou, M., & Mansouri, K. (2023). Dysgraphia detection based on convolutional neural networks and child-robot interaction. *International Journal of Electrical and Computer Engineering (IJECE)*, *13*(3), 2999–3009. https://doi.org/10.11591/ijece.v13i3
Hopcan, S., & Tokel, S. T. (2022). The views of special education teachers about a mobile writing application. *Research on Education and Psychology*, *6*(1), 84–100.
Kagohara, D. M., van der Meer, L., Ramdoss, S., O'Reilly, M. F., Lancioni, G. E., Davis, T. N., Rispoli, M., Lang, R., Marschik, P. B., & Sutherland, D. (2013). Using iPods® and iPads® in teaching programs for individuals with developmental disabilities: A systematic review. *Research in Developmental Disabilities*, *34*(1), 147–156. https://doi.org/dx.doi.org/10.1016/j.ridd.2012.07.027
Kohli, A., Sharma, S., & Padhy, S. K. (2018). Specific learning disabilities: issues that remain unanswered. *Indian Journal of Psychological Medicine*, *40*(5), 399–405. https://doi.org/10.4103/IJPSYM.IJPSYM_86_18
Lomurno, E., Dui, L. G., Gatto, M., Bollettino, M., Matteucci, M., & Ferrante, S.

(2023). Deep learning and procrustes analysis for early dysgraphia risk detection with a tablet application. *Life*, *13*(3), 598. https://doi.org/10.3390/life13030598

Madeiraa, J., Silvaa, C., Marcelinoa, L., & Ferreiraa, P. (2015). Assistive mobile applications for dyslexia. *Procedia Computer Science*, *64*, 417–424.

Molina-Vargas, G., Arias-Flores, H., & Jadán-Guerrero, J. (2021). Benefit of developing assistive technology for writing. *Intelligent Human Systems Integration 2021: Proceedings of the 4th International Conference on Intelligent Human Systems Integration (IHSI 2021): Integrating People and Intelligent Systems, February 22-24, 2021, Palermo, Italy*, 586–590.

Moreau, D., & Waldie, K. E. (2016). Developmental learning disorders: from generic interventions to individualized remediation. *Frontiers in Psychology*, *6*, 1–8. https://doi.org/10.3389/fpsyg.2015.02053 Edited

Muktamath, V. U., Hegde, P. R., & Chand, S. (2021). Types of specific learning disability. *Learning Disabilities*. https://api.semanticscholar.org/CorpusID:245401668

Muthumal, S. A. D. M., Neranga, K. T., Harshanath, S. M. B., Sandeepa, V. D. R. P., Lihinikaduwa, D. N. R., & Rajapaksha, U. U. S. K. (2022). Mobile and simulation-based approach to reduce the dyslexia with children learning disabilities. *2022 IEEE 10th Region 10 Humanitarian Technology Conference (R10-HTC)*, 311–317. https://api.semanticscholar.org/CorpusID:253271120

Nurchaerani, M., Hartadhi, S. H. R., Alfian, A., & Sadikin, I. S. (2022). How is perseveration in dysgraphia students? A research at yayasan pantara jakarta. *Pedagonal : Jurnal Ilmiah Pendidikan*, *6*(2), 283–291. https://doi.org/10.55215/pedagonal.v6i2.5644 ?

Pee, N. C., Sibgatullah, A. S., & Mohtaram, S. (2014). Mobile dyslexia screening test: A new approach through (multiple-deficit) model mobile game to screen developmental dyslexia children. *Environment*, *8*(11), 14.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. In *American psychologist* (Vol. 55, Issue 1). American Psychological Association.

Sihwi, S. W., Fikri, K., & Aziz, A. (2019). Dysgraphia identification from handwriting with support vector machine method. *Journal of Physics: Conference Series*, *1201*(1), 12050. https://doi.org/10.1088/1742-6596/1201/1/012050

Vygotsky, L. S., & Cole, M. (1978). *Mind in society: Development of higher psychological processes*. Harvard university press.

Williams, P., Jamali, H. R., & Nicholas, D. (2006). Using ICT with people with special education needs: what the literature tells us. *Perspectives*, *58*(4), 330–345. https://doi.org/10.1108/00012530610687704

Zain, N. Z. M., Mahmud, M., & Hassan, A. (2013). Utilization of mobile apps among student with learning disability from Islamic perspective. *2013 5th International Conference on Information and Communication Technology for the Muslim World (ICT4M)*, 1–4. https://doi.org/10.1109/ICT4M.2013.6518889