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Reading Activities on Tablets for Improving Fluency and Comprehension in Primary Education

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Abstract: Reading literacy is a central focus of primary education and a prerequisite for engagement in the broader educational context. Since modern society is being impacted by technologies, more efficient learning approaches are needed for core skills like reading. While mobile learning is a rapidly growing field in education, the question remains: can it be effectively integrated into classroom settings? The study examines the progress of sixteen multilingual first graders learning English in the Czech Republic, over a four-month period using tablets, focusing on the following sections; reading fluency and comprehension. More specifically, design-based research was applied to provide an in-depth and comprehensive examination of the pedagogical impact of innovative designs within handheld devices, through iterative testing, analysis and refinement in authentic classroom settings. Results suggest potential improvements in post-test scores, with students reading faster, making fewer errors and showing a better understanding of the texts. Furthermore, the use of various gamified applications also increased students' motivation and enthusiasm for reading. The findings emphasize the value of using mobile learning technologies in reading literacy instruction as a key tool to improve the performance of young readers.

Keywords: reading fluency, reading comprehension, mobile technologies, mobile learning, primary education

Introduction

Theoretical Background

In today's rapidly expanding educational landscape, technology plays a vital role in transforming how and where learning takes place, extending beyond specific periods. Sustainable access to social media, networking tools and digital knowledge resources through electronic devices has become an integral part of modern education. In the early stages, computers were used within existing infrastructure, but their application gradually developed. Over time, the trend shifted toward faster and more

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convenient access, through smaller yet more powerful devices. This evolution brought mobile phones, smartphones, tablets, PDAs, iPads, iPods, netbooks and similar portable devices into prominence, leading to the emergence of the term *"mobile learning"* (or m-learning). While its precise conceptualization has been widely debated, all definitions agree to the fact that it allows people to learn in an *"anywhere"* and *"anytime"* manner and to access information whenever needed (e.g. Quinn, 2000; Kukulska-Hulme, 2007; Mehdipour & Zerehkafi, 2013). Researchers have noted the dynamics of mobile technologies as flexibility, accessibility, interactivity and engagement (Liu et al., 2014), recognizing its impact on the quality of education and its potential to lead to new regulations, platforms and solutions for future facts (Basilaia & Kvavadze, 2020), with the ultimate goal of introducing them into curricula and creating teaching techniques (Toquero, 2020). Mobile learning became even more popular due to the recent emergency that arose around the world. The COVID-19 pandemic has changed the entire education system globally (Saikat et al., 2021) and the new generation integrated digital tools into their daily routines, they adapted and modified the innovations to suit their specific needs and preferences.

Building on that research, the role of mobile learning is important to be examined particularly in subjects like literacy. While proficiency in reading and writing traditional texts remains important, it is no longer sufficient on its own (Lankshear and Knobel, 2011). To begin with, reading is the ability to understand various types of texts for both learning and pleasure and apply written language forms that are meaningful to society and valued by individuals (Mullis et al., 2006; OECD, 2001). But let's clarify what effective reading requires; fluency and comprehension, which means allowing readers not only to recognize words efficiently but also to understand them in context (Davis, 2006). Research has shown that these two pillars are closely connected in reading, with each helping to strengthen the other and a complete definition of each must highlight its strong link to the other (National Reading Panel, 2000). Nowadays reading literacy extends beyond printed texts; it is the ability to decode, encode and interpret meaning not just through words, but also through signs, symbols, images, sounds and movements in digital spaces. International literacy assessments like PIRLS and PISA now include on-screen reading, acknowledging the growing expectation for children to engage with digital textbooks. It is a fundamental skill necessary for success in academic, personal and professional settings and is a key component in lifelong learning and development to become a useful member of modern society (Wildová, 2014). For that reason, encouraging children's natural

acquisition of reading skills from a very young age remains essential, requiring a stimulating environment and appropriate teaching methods to spark their interest (Wildová & Kropáčková, 2015).

Related Work

There is a growing need to enrich educational settings with digital tools, as they have proven effective in supporting reading activities and promoting engagement. Since the younger generation embraces mobile technologies in their daily lives, their influence on reading habits becomes more evident. Many children now have access to devices and the internet at home, with a significant number already engaging in electronic reading outside of school. A study by the National Literacy Foundation (Picton, 2014) revealed that 70% of children prefer tablets and smartphones for reading, indicating a lower proportion of children engage in print reading compared to that format. As this is a relatively new area of study, research findings remain inconsistent and diverse, emphasizing the need for further exploration.

In terms of reading fluency, most recent studies involved experimental methods or pre- and post-tests, with predominantly positive results observed in general elementary education. For instance, the study of Al Ali et al. (2024) involved 104 students in the second grade, divided into two groups. The experimental group dove into gamified learning, playing interactive games with rewards and exploring a digital library with group reading and discussion, while the control group worked in traditional settings. After measuring fluency, originality and flexibility, the results were clear; students using games read more confidently and smoothly, practiced and challenged more and had fun doing it. Gamified reading not only made learning enjoyable but worked well for different types of learners in various settings. Another study (Ahmed et al., 2022) worked with children around 12 years old who read a daily 55-minute block using tablets. With a mixed-methods approach, the researchers gathered detailed insights into reading fluency, which came from how the tablets were used. They offered interactive, scaffolded and engaging experiences that helped students focus, process stories more easily and practice reading again and again without feeling intimidated. For students with learning difficulties, tablets also made reading less stressful and more fun, allowing them to sustain attention, read more words and see their fluency improve dramatically. A few key takeaways: first, schools should make this technology available to every student who could benefit from it; second, teachers should be encouraged to integrate tablets into their lessons for reading. On a different note, a study in Turkey by Isik (2023) examined the reading skills of third- and

fourth-grade students across these two formats: paper and screen. Interestingly, the results showed no significant differences in overall reading ability between the two mediums, although fourth graders read more words correctly, faster and with better expression than third graders. The author concluded that, since students' reading performance is similar on mobile devices and on books, schools can support the use of electronic media, which offers convenience, easier information sharing and cost savings. The study also highlighted that the widespread use of technology contributes to the unconscious development of screen reading skills, which are increasingly important for communication, information access and instruction in educational settings.

Among the studies that are analyzed, reading comprehension was the one that was examined the most. Prados Sánchez et al. (2023) conducted a quasi-experimental study with 85 fourth graders using a gamified platform for various reading activities and found that students in the experimental group achieved significantly higher reading comprehension scores and reported more positive attitudes toward reading than the control group. Multimodal, interactive experiences, incorporating images, colors and shapes, appear to reinforce reflective thinking and greater confidence in comprehension. Hsiao and Chen (2015) investigated what makes children more motivated to learn with mobile devices, specifically e-readers, focusing on how technology affects reading comprehension. They worked with third grade students and used, as well, a quasi-experimental design where students read interactive e-books that included animations, sounds and clickable features. The results showed that students who used these e-books understood main ideas more easily and demonstrated higher comprehension, likely because the multimedia features increased concentration and helped them *"catch the point"* of the story. Furthermore, Moon, Francom and Wold (2021) examined how different approaches to using iPads affect reading comprehension in 47 pupils in fifth grade. The study compared a *"learning from technology"* approach, where students passively received content, with a *"learning with technology"* approach, in which students actively created digital products such as comics, concept maps, presentations and animations to demonstrate understanding. Conducted over an eight-week period of reading related activities, the study found that students in the *"learning with technology"* class felt more control and showed greater attention. However, a point of interest is that comprehension lasted only during the study and returned to pre-study levels once the activities ended, likely due to activities being suspended, which may have led to a loss of motivation and learning among participants. This was

reported from other studies that the effect was significant only during short-term use (Kaman & Ertem, 2018), who investigated the impact of digital texts on 30 primary students in fourth grade in Turkey. The participants were assigned to an experimental group with tablets and a control group with printed materials. Texts were selected from three types of Turkish lesson themes, including storytelling, informative and poetic texts. The longer the activity lasted, the smaller the overall impact of reading digital text in comprehension. The opposite happened with printed ones; extending the activity had a meaningful impact on the reading comprehension control group.

Some of the research has specifically examined the relationship of mobile devices with English as a second or foreign language (ESL/EFL). Research in this field is wide and tends to emphasize in key reading skills such as phonological awareness and grammatical knowledge (Hori et al., 2025), vocabulary acquisition (Yang et al., 2025) or overall academic performance, fluency and comprehension with students feeling happy and showing a positive attitude toward mobile devices in English classes (Al-Omari & AbuSeileek, 2023). Much of it is concentrated in the age of upper primary or junior high school to university levels (e.g. Al-Jarf, 2022; Honarzad & Soyoof, 2023). Systematic reviews from a decade till now (e.g. Gutiérrez-Colón, Frumuselu & Curell, 2023; Alotaibi & Zeidan, 2023) reveal limited data on primary school students learning to read in English as a second or foreign language with the valuable mobile ICT or game-based learning tools.

In a study involving 120 fourth graders, participants were assigned to either gamified or traditional instruction groups and their English skills, including reading comprehension, were evaluated before and after the program. Findings indicated that students who experienced various gamified activities showed significantly greater gains in reading understanding ($F = 18.93$, $p < 0.001$) compared to their peers in the control group (Tayeh, Krishan & Malkawi, 2024). Similarly, Nitiasih and Budiartha (2021) conducted a study with 31 students learning English in grade five and once again gamifying local Balinese stories had a positive impact in post-test scores on reading comprehension because of the interactive and engaging format which encouraged active participation and provided opportunities to respond to questions correctly. The frequency of the students raising their hand when they wanted to answer the question given, suggests that incorporating culturally relevant stories in mobile game apps promotes motivation which is also essential for comprehension. Alharbi (2022) developed and evaluated a mobile reading application based on Universal Design for Learning and digital storytelling with second grade primary

EFL students and found that it significantly improved reading fluency and comprehension. Self-paced storytelling activities helped students to read more accurately, smoothly and with prosody in the experimental group. Moreover, Zahran (2025) investigated the impact of using Nearpod, an interactive presentation app, with images, web content, drawing boards, filling the gap, polls and quizzes. In combination with a guided reading strategy on EFL Egyptian primary pupils, students who received instruction through technology significantly outperformed their peers that continue working with traditional methods in reading comprehension. The author notes that the application's activities meet young learners' preferences and should be integrated into elementary reading classrooms, as they encourage interaction, friendly competition, reduce anxiety and cultivate positive attitudes toward reading (Zahran, 2025). On the other hand, not all digital reading contexts were equally effective. Salmerón et al. (2021) found that 10–13 year old Spanish EFL students, especially the ones with lower reading skills had more trouble comprehending informational passages on tablets than on paper. This might be because they associated tablets more with fun activities, like games, rather than academic reading. Liman Kaban and Karadeniz (2021) conducted research with sixth grade students in Turkey including personalized, gamified and PDF formats on how their views of these practices affected their reading comprehension and motivation in English as a foreign language class. The findings showed that while there was no significant difference in comprehension between, students who read on screen reported significantly higher levels of motivation.

Although digital reading offers many benefits, studies of primary school cohorts have found that it correlates with lower reading outcomes (e.g. Delgado et al., 2018; Reich et al., 2016). It seems that may negatively affect concentration and users are also more prone to distractions such as browsing the web, playing games and visiting social networking websites, frequently focusing on the device rather than the content (O'Toole & Kannass, 2018). Overemphasis on rewards or leaderboards can distract from content and issues like unequal access, privacy concerns and short novelty add further challenges (Mirzaie Feiz Abadi et al., 2022). Moreover, children who have primarily used tablets for entertainment at home may perceive these devices as tools for play rather than learning, so it is reasonable to assume that they may adopt a more relaxed approach (Salmerón et al., 2021). Another barrier seems to be the availability of Wi-Fi support with slow internet connection that may lead to negative emotional experiences (Ebadi & Ashrafabadi, 2022) and the institutional technological infrastructure that

may not work properly and affect learning (Crompton, 2013), the high cost of devices, as well as the need to purchase educational apps, many of which are not free (Henderson & Yeow, 2012). Other technical challenges include the size of the tools, risk of sudden obsolescence, frequent changes in device models, battery life and security (Sarkar, 2021). Lastly, there is also a growing concern about the overuse of technology among children. Excessive screen time can negatively impact mental health, attention, sleep quality, physical activity and social development (Twenge & Campbell, 2018; Priftis & Panagiotakos, 2023). Consequently, many schools are implementing policies to limit or carefully manage mobile devices to balance educational benefits with student well-being. At the same time, they should not be entirely removed from educational contexts; instead, their effectiveness depends largely on how, when and for what purpose they are used. When they are purposefully designed and pedagogically guided, they can support learning without contributing to problematic overuse (OECD, 2024).

Research Aim & Questions

As it has been demonstrated in the previous chapter, by providing interactive experiences through handheld devices there might be a huge potential to foster positive results in educational environments. It is notable that this technology became accessible some years ago, making them still relatively new hardware. Due to this and other factors that have been discussed, there is still limited targeted investigation on the application of m-learning that has been narrowed to the effect on reading in compulsory education. Building on this foundation, the aim of this research is to examine how mobile devices can impact reading skills among primary school students. More specifically, it examines students' progress in grade one over a four-month period using tablets in a bilingual school, focusing on the key aspects: reading fluency and reading comprehension.

On the basis of the existing literature are formulated the following questions:

Q1: To what extent does the use of mobile devices in the classroom improve English reading fluency among first grade elementary school students at a bilingual school?

Q2: How does the use of mobile devices affect English reading comprehension and support understanding of texts in grade one in a bilingual primary school?

2. Methodology

Research Design

The research approach adopted is qualitative and design-based research (DBR) is the chosen methodology, as it perfectly

aligns with the goal of the current study. The term first appeared in 1992 as a *"design experiment"* and its concept was introduced as a new method in educational research (Brown, 1992; Collins, 1992). Since then, the approach has evolved and is now commonly referred to as *"design-based research"*, continuing to develop and adapt in the field. This approach proves to be particularly appealing and effective in settings like kindergartens and elementary schools, especially when integrating technology (Wang & Hannafin, 2005). The focus of this tool lays on developing and refining educational practices, theories and artifacts through repetitive cycles of design, implementation, analysis and redesign of a product in real-world settings, while encouraging a dynamic interaction between the researchers and the participants (Wang & Hannafin, 2005). In short, it uncovers what is happening beneath the surface when students' thinking changes in response to instructional interventions and it also examines what students do, how they behave, what ideas they form and how they interact socially in that learning environment (Barab, 2014). The framework of design-based research as outlined by Anderson and Shattuck (2012), includes the five following characteristics: (a) iterative process, (b) integration of theory and practice, (c) collaboration between stakeholders (researchers and practitioners), (d) application in real educational contexts and (e) use of multiple data sources by mixed methods. Other studies, such as those by Design-Based Research Collective (2003), McKenney & Reeves (2013) or Zheng (2015) are in agreement with that conceptual framework described in more detail in the next paragraphs.

Mobile learning is a complex phenomenon that requires long-term investigation and multiple forms of data collection. Design-based research was selected for this study because it supports iterative cycles of design, implementation, analysis and refinement. In the beginning, the study followed the initial phase, which included selecting mobile applications, the objectives of each activity and the execution plan. In parallel, the literature was reviewed. At this stage, the purpose and research questions for the development iteration were formulated, as it was deemed essential to identify them before beginning the intervention. After that, indeed it was the actual implementation (first cycle). Data was collected and analyzed to determine what worked well and what needed improvement. For instance, if a particular application or activity did not significantly have results in reading fluency or comprehension, adjustments were made to better align with the research' needs. Based on the insights, the refinements that were made led to a new iteration of the design (second cycle) and so on (third, fourth, etc). In each cycle, they planned solutions using relevant educational theories

and bibliography related to early literacy, reading skills, digital technologies and the use of ICTs and mobile learning for primary education. At the same time, the research was grounded in various methodological approaches, action research, case studies, experimental methods and not only, with a huge variety of tools used. The fundamental element of DBR, which is collaboration between researchers and practitioners, was more than needed in the current study. Teachers and school staff worked closely with the researchers, since they are the ones having experience with students, being aware of the classroom achievements and dynamics and knowing the needs of each student. When teachers' ideas and concerns are included in the design process, every innovation works better, since they are based on actual experiences and are more likely to be used in other classrooms. What is often missing from research is concrete action, as many studies focus mainly on statistical results or reported perceptions without directly experiencing the challenges involved (Armstrong, Dopp & Welsh, 2022). It is more than obvious that DBR not only evaluates the effectiveness of a new tool, in this occasion the m-learning environment for reading, through theories, but it examines it in real-world educational settings. Lastly, the study utilized multiple data collection methods, which will be examined in greater detail in the following chapters.

Participants

The sample consisted of 16 first graders (6–7 years old), 7 girls and 9 boys, who were attending a bilingual school in Prague, Czech Republic. The school works with multilingual students from different countries all over the world who have varying knowledge of Czech and English, with small class sizes that allow personalized lessons to meet individual student needs. The main courses, literacy and math, are taught in both languages, while others such as science, arts or music, are only taught in English. Most of them have already attended an English preschool and they also speak English with their friends. At home, they speak their native language. Only one of the students is considered native English speaker, coming from America.

Regarding whether they have any exposure to mobile or electronic devices at home, it seems that a percentage of n=64,70% do (Table 2). Out of 16 students, 10 own a tablet or iPad, while others might rely on phones, laptops or have no personal device. The main purposes of use include games and videos. Usage frequency varies from very little to almost every day. Most of them rarely use tablets and when it happens they use primarily for games and videos, focusing on entertainment. Only a small percentage, approximately 3 to 4 students, use these devices more frequently, several days per week. Most students who read on their portable devices report high

interest, particularly those who use them for entertaining reasons, while a few students do not engage in reading on their devices. When the research first began, the school introduced tablets as a new innovation, distributing 20 tablets that teachers could reserve for their classes. Prior to this, the only technological advancement in the school was the use of smartboards in every classroom. The English teacher, with many years of experience in primary education, was in her first year at this specific school. However, the students were already well-acquainted with her, as the research was being conducted in the second academic semester. Her expertise proved invaluable; she could assess the students' language levels and assist the researchers with materials, tests and questionnaires. Additionally, information was collected from other teachers who had been working with the students in various classes. The data is kept anonymous and each student will be referred to in the project using the nickname *"Student"* followed by a unique number, denoted by the letter *"S"* (e.g. S1, S2, etc.).

Tools

The methodological data collection process began with both participatory and non-participatory classroom observation. The use of observation in this study served two main purposes: firstly to familiarize the students with the researcher's presence in the classroom and secondly to gather data on the students' participation in the lesson, their reading abilities in English language and the teaching techniques used by the teacher. As a tool, observation offered several advantages because it allowed researchers to observe events first-hand for more accurate and reliable data. It also helped for the subsequent organization of the intervention to be as close as possible to the students' needs.

The main tool for examining their reading fluency and comprehension was the students' pre- and post-tests. The pre-tests involved a text that was inspired by the book *"Biff's Fun Phonics"*, a non-entirely unfamiliar passage, comprising 90 words. The children were instructed to read the text aloud and the number of words they read was recorded over one minute to assess their fluency. Additionally, five comprehension questions were included based on the content of the text to evaluate their understanding. The post-test consisted of a more advanced text that included both familiar and new words (133 words). The rationale behind this was that students had primarily been learning these words through repetitive activities on the tablets. The inclusion of new words aimed to assess whether they had truly mastered the spelling of words and whether they were prepared to comprehend additional vocabulary they had encountered over time. Unpracticed texts allow researchers to measure

genuine improvements rather than just gains due to text memorization (Nes Ferrara, 2005). Moreover, using exactly the same tests would not give useful or reliable results because, at the beginning, the students are not familiar with the content (Marsden & Torgerson, 2012). Reading fluency and comprehension is text-dependent and best assessed using different but equivalent texts (Scholin & Burns, 2012). The teacher played a key role in shaping the difficulty of tasks and materials ensuring that they were appropriate for their language level, in cooperation with school practitioners and the researchers.

Furthermore, a questionnaire with closed type questions about the demographic characteristics was distributed and the use of digital devices at home, including frequency and reasons for use. It's important to note that the questions were adjusted to match the students' English language level based on the observation data without complex vocabulary. At the end of the intervention, students were also asked to respond to simple questions regarding their experience. In the post-test phase, the questionnaire items served as a theoretical basis for developing the semi-structured interviews to strengthen the design-based research scheme. The interviews included open-ended questions to not only help share views regarding the predetermined questions but also flexibly add new thoughts. For instance, students were asked about their experience of the intervention and whether they felt they had learned anything valuable from it. Afterwards, it investigated detailed thoughts on tablets as a tool for reading skills, preferred applications, etc. When answers were not sufficiently clear, follow-up clarifications were requested. Questionnaire and interview instruments addressed similar themes within the same learning contexts, allowing the two data sources to complement and enrich one another (Harris & Brown, 2010).

Moreover, the diary by the researcher was the main tool for controlling the entire research daily and was carried out after the conduct of each lesson when using tablets. The diaries were not only descriptive of their scores in activities, but the descriptions were accompanied by the interpretation of the notes, which functioned as means of reflecting on educational practices. The use of records in a diary was considered a necessary condition for the systematization of the effort to understand, but also to monitor the entire research and redesign process.

Lastly, various mobile applications were employed as part of the data collection. The topic of that didactic materials was chosen based on the curriculum and the level of students, followed by the school, without introducing unrelated content. The researchers and the teacher selected carefully the applications and the activities on them with the ultimate

goal of improving reading fluency and comprehension, described below.

Materials

The most frequent application was *"Kahoot!"*, a widely known game-based learning platform. In this app, questions are displayed on the smartboard and students respond using their tablets. Activities are timed and primarily consist of multiple-choice or true-or-false questions (Figure 1 & 2). Another similar platform named *"Blooket"* was also used with the same quiz elements and a variety of game modes (Figure 3). The difference between the two platforms is that in Blooket questions are displayed repeatedly on students' tablets rather than on the smartboard until the game ends at the teacher's selected time. Furthermore, they can earn either coins or points during activities which adds a huge incentive (Figure 4). Another example is *"English comprehension"*, an educational app made for young learners in 1st, 2nd and 3rd grades. Its primary goal is to help children improve their reading comprehension skills by offering a variety of stories at different levels. Each story is followed by questions to test their understanding of the text and once all answers are correct, they can progress to the next level. Lastly, one more oftenly used application was *"Wordwall"*, that offers a wide range of templates for various activities, including quizzes, match-ups, word searches and crosswords, which can be easily tailored to fit specific learning goals. Other activities were as well used, during the design-based research phases, but less often and in a combination of the above (e.g. Youtube, Pear Deck).

Example of activity (Figure 1)

Activity description: Students participated in a 10-question quiz, answering based on a short text of 3–4 sentences displayed on the board. The text included familiar vocabulary that students had encountered but not extensively practiced, with many CVC words and a few unfamiliar ones to assess their ability to comprehend in context. Sufficient time was provided to all students, including slower responders, who could complete the activity.

Activity goals

- Improve reading comprehension by extracting keywords from short texts and answering related questions.
- Enhance reading fluency by encouraging students to read smoothly, accurately and with appropriate pacing while answering questions.
- Develop vocabulary recognition and understanding of familiar words while introducing new ones in context.
- Use the interactive and competitive nature of Kahoot! to keep students

Fig 1: Kahoot! question format displayed on a large screen.

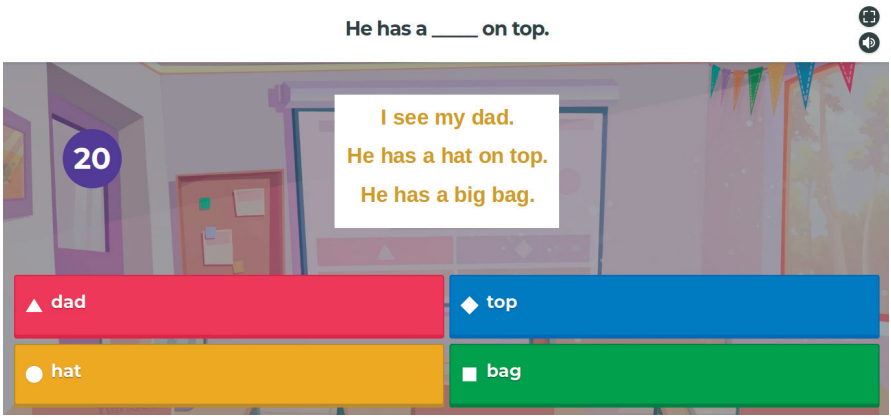
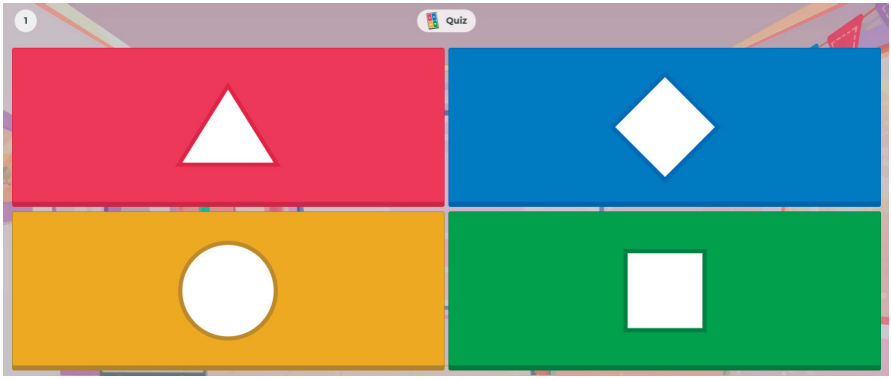


Fig 2: Kahoot! answer format displayed on the tablet.



motivated and engaged while practicing reading skills.
- Increase reading confidence where students feel comfortable engaging with texts at their level.
- Identify which areas of the text or specific reading skills need further review or instruction based on student responses.
- Provide instant feedback on students' answers to clarify misconceptions on incorrect answers.

Fig 3: Blooket question format displayed on the tablet.

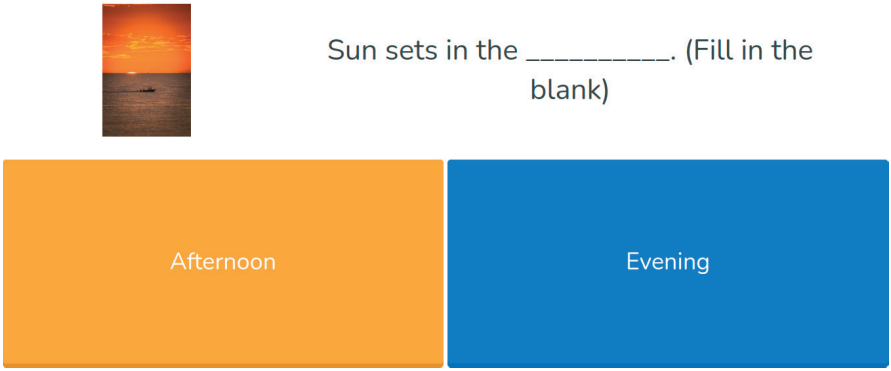
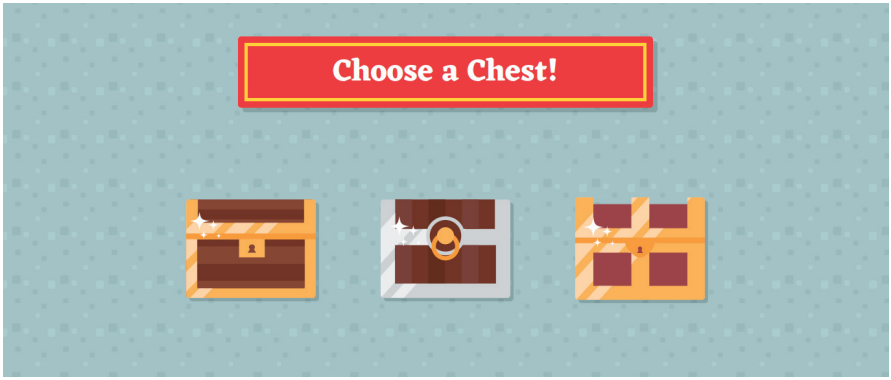


Fig 4: Example of Blooket challenges for winning extra points on the tablet.



Example of activity (Figure 3)

Activity description: Students were asked to use Blooket for 15 minutes, to engage in a fill-in-the-blank quiz, with 20 questions designed to improve reading fluency, comprehension and motivation.

The activity presented students with sentences with keywords missing. They were tasked with selecting the correct word from a set of options to complete the sentences.

Activity goals

- Enhance reading fluency by encouraging students to quickly recall and apply vocabulary, helping to improve reading speed and accuracy.
- Improve reading comprehension by requiring students to understand the sentence and select the appropriate word that fits the context.
- Increase motivation through the gamified nature of the activity, where students are rewarded for correct answers and progress, making the learning process more engaging.
- Reflect more carefully on their answers and learn new things through repetition of information instead of passively absorbing facts presented.
- Provide instant feedback on students‘ incorrect answers encouraging retention and correct usage of vocabulary.

Selection of Educational Materials

The selection process was guided by technical, contextual and mainly pedagogical considerations and all applications were tested through practitioners in advance to ensure their suitability for grade one pupils and alignment with the general objectives of the study (Felicia, 2009). According to Felicia (2009), from a technical perspective, priority was given to tools with a clear, intuitive interface that young learners could navigate independently (e.g. Kahoot!, Blooket). Additional features such as audio control options, short activity duration and easy access across devices were also considered important for classroom integration (e.g Wordwall). Customization options, including adjustable difficulty levels and task formats, were valued for supporting differentiated learning (e.g. English reading comprehension). She continues that contextual factors such as age appropriateness, language level and time required to complete activities should be carefully evaluated to ensure that tasks could be completed within limited classroom time. Pedagogically, emphasis was placed on applications that offer a gentle learning curve, clear objectives, visible progression and immediate, supportive feedback. Opportunities for collaboration and peer interaction were also considered essential, as competitive and cooperative game modes can enhance motivation and social engagement. It is important to also consider teachers' attitudes and experiences when implementing educational applications, as many may be using such tools experimentally rather than with prior expertise. From their perspective, personalized guidance, immediate feedback and emotional support remain fundamental for students' holistic development (Reche et al., 2024). Applications such as the ones described exemplify this balance. Kahoot! is one of the most frequently used applications in the literature, making it difficult to exclude from this study. Its widespread,

positive use and ease of implementation also help teachers feel more confident and comfortable using it in the classroom (Stakhova et al., 2024).

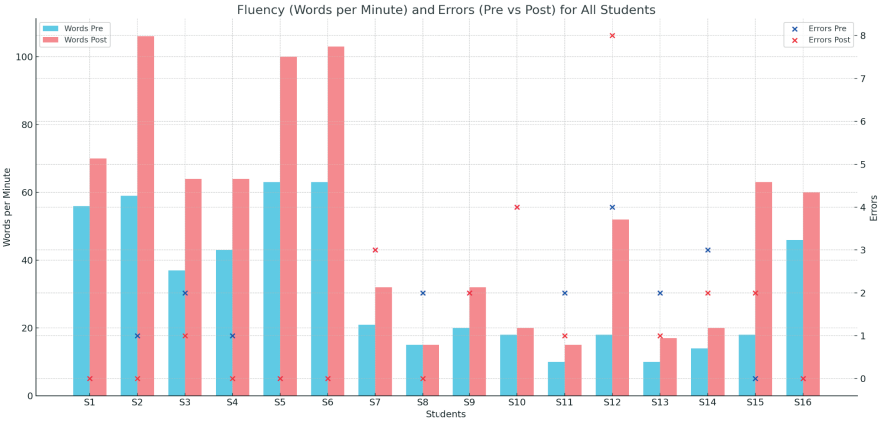
Procedure

The process of collecting data from each participant was done individually, in a quiet place and in the presence of only the researcher. The study was conducted in accordance with ethical research guidelines; written informed consent was provided by parents, while students gave their verbal assent to participate in the study. Before data collection, participants were informed about the objectives of the study and the procedures to be followed and were assured that all recorded data would be used only for research purposes and the responses are confidential and their anonymity will be strictly secured. After the preliminary stages, the experiential part began, from 15/02/2024 to 15/06/2024. The first week prior the intervention was only the observation. The tablets were introduced at a frequency level of approximately three times a week for two teaching hours during the English language lesson. Both the researcher and the teacher thoroughly explained what a tablet is, how it works and what it was expected while using them. Each activity was as well explained in detail when it was time to implement them during the designated weeks. On the first time, only five tablets were introduced, allowing the kids to take turns using them to become familiar with the devices. The next step involved placing one tablet on each desk, as they were seated in pairs and ended the bigger part of the study to work individually. Certain activities were intentionally designed to be completed by groups of two or three students to promote collaboration and teamwork. Over time, students became capable of independently connecting to the applications on their own by typing in the web, logging in the game, writing the password and their nickname.

Data Analysis Framework

Since DBR involves continuous cycles and multiple types of data resources they will be analyzed from different perspectives for more comprehensive outcomes. Content analysis and thematic analysis will be used; they are widely used analysis methods in qualitative research because they offer systematic and transparent procedures for organizing and interpreting non-numeric data, which helps to make the analytical process clear and replicable for children (Vaismoradi & Snelgrove, 2019). Both involve coding data and then grouping those codes into larger categories or themes that reveal patterns and insights relevant to the research question. Content analysis will systematically categorize and quantify

Table 1: Students reading fluency achievements, words they read per minute in pre and post tests.



data, breaking it into manageable pieces for evaluation. That means results from the pre- and post-tests individually for each student, their written or verbal responses and their scores from activities within mobile applications. Their performance across different reading tasks will be tracked and relate them with demographic characteristics and past interactions with reading materials and technology. Each student's data will be analyzed separately, then compared across groups for a detailed understanding of trends in relation to factors mentioned. Meanwhile, thematic analysis is mandatory to interpret those results and identify the recurring themes and patterns of participants' experiences.

Results

Fluency academic performance

From the data gathered, there is a difference between the pre- and post-tests in the number of words students read per minute and the errors they made (Table 1). On average, students read 47.8% more words in the post-test compared to the pre-test and their reading speed improved, with a 63.3% increase in words read per minute, rising from 31.9 words to 52.1. The mean number of errors decreased slightly by about 6%, which means their error rate per word actually improved, if we consider the

amount in words read in the post phase. Following up to the table below, it will be presented case studies of students to draw conclusions from their post-test responses and open-ended questions.

To begin with, S12, a foreign boy with only half a year of English learning and no spoken at home, showed progress with the use of the tablet, by increasing his reading output by a factor of 1.89, meaning he nearly doubled the reading performance almost twice over from pre- to post-test. His engagement levels were lower when using traditional methods, often appearing bored and unmotivated. The kid explained *"I learn better with a tablet. I focus more because I like using a tablet, but books make me distracted. I love it!"*. Apart from that, the reduction in errors showed a positive trend in reading accuracy with fewer mispronunciations and less skipping of words. Similarly, S15, she showed an extraordinary level of engagement when using the tablets compared to paper books from 18 words to 63, an increase of over 50% after four months of using the devices. Although she owns a tablet, using it occasionally for games, she doesn't regularly read on it. According to the feedback this high level of enthusiasm with reading materials in the school's tablets contributed to the ability to learn new vocabulary, an important factor to increase fluency. The apps supported the acquisition of words in a different manner and the ones that had more of a competitive character *"make me feel that I want to achieve so I was focused on reading properly"*.

An interesting observation emerged with S7, from Czechia, who has been learning English for two years and does not speak the language at home but he regularly uses it with friends. It is also a student who had frequent access to a tablet at home. His familiarity with the device seemed to give him an apparent advantage during activities like Blooket, which required quick thinking and fast responses. Although S7's progress wasn't dramatic, it showed steady and consistent improvement over time. Initially S7 showed limited participation and struggled with unfamiliar or complex words, often pausing or hesitating. He increased his reading speed from 21 to 32 words per minute. As classroom activities increasingly integrated tablets, S7's convenience and proficiency with the device led to developments in word recognition, reduced hesitation and a stronger grasp of vocabulary, ultimately boosting his reading accuracy and general confidence.

S10, appears to have shown stable results without any difference from the pre-tests. This student often expressed how much he enjoyed the applications, calling them "*super fun*". However, he did mention a challenge with some of the games, like Kahoot! and Blooket, which had fast-paced time limits. *"The speed sometimes made me feel stressed*

to read and pressured to answer quickly", which impacted the ability to read with speed, accuracy and with expression. Interestingly, when the activities became more personalized and student-centered, allowing him to work at his own pace individually on a tablet, he demonstrated greater comfort and confidence. Activities such as anagrams, crosswords and fill-in-the-gaps were particularly effective for improving word decoding, learning correct spellings and building a stronger vocabulary, which helped focus more carefully and reduce mistakes during reading.

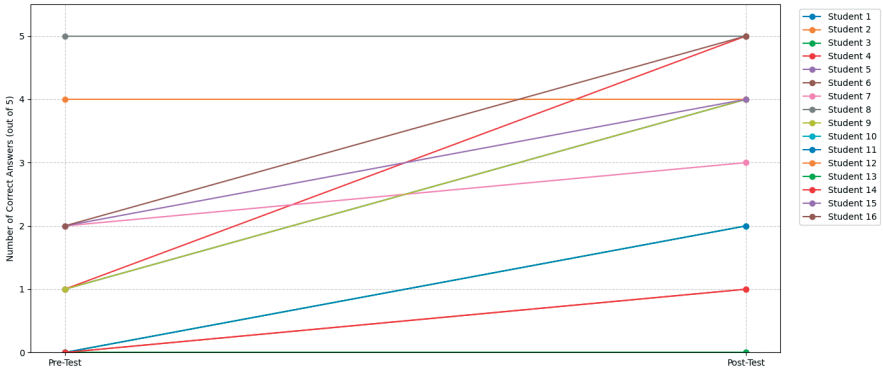
It is also worth mentioning that S6, who is the one girl coming from an English speaking country, excelled in reading fluency and continues to perform well in this area. The results highlight an outcome: students for whom English is a second language might face further challenges in achieving fluency. Tablets helped to move from 63 to 103 words per minute, with zero errors in both assessments, demonstrating not only speed but also excellent prosody and accuracy. Unlike her peers, S6 likely entered the study with a solid foundation in vocabulary, grammar and phonemic awareness, which allowed her to benefit from the mobile learning intervention in a different way. Rather than catching up, she was able to extend and refine her skills. Her familiarity with English may have also enabled her to engage more deeply with the content of reading tasks, rather than focusing on decoding or basic comprehension. Lastly, she frequently requested to use the tablets in class, describing how much she valued the tool. The specific pupil called the tablet an *"amazing device"* and stated that she prefers it over traditional print-based reading activities, which she finds less appealing, even though she was, anyways, an excellent student.

Comprehension academic performance

Regarding comprehension, almost all participants were able to reply to at least more than one question of the text given at the end of the process (Table 2). On average, they answered 2.63 out of 5 questions correctly before the intervention and 3.75 out of 5 after it; this means their performance increased by about 42.6% overall.

As reflected in the data, S8, S9 and S12, initially identified as having poor understanding abilities of the material in the pre-tests, but over the time of the intervention, they acquired basic skills that enriched their performance. For instance, S8 expressed the enthusiasm for using the tablet, emphasizing: *"It's more fun to reply to questions on the tablet, I pay more attention to the meaning of the text because I like using the device. Books are also nice but when I have to read I am not focused much"*. The interactive nature of the tablet contributed to a higher

Table 2: Individual student progress in reading comprehension from pre- to post-tests.



level of concentration and understanding of the text. Apart from that, S9 increased the score from 1/5 questions to 4/5 and according to the background data, the kid used mobile devices regularly at home for only entertainment purposes. That perspective with the frequent digital exposure, even if it is non-educational, seemed better able to adapt to the mobile learning format. S9: *"Videos and sounds helped me look at them, as the combination of pictures, colors and sounds make the stories more attractive"*.

Other examples include the ones related to the English comprehension application. In the very first initial attempt, students 11, 13 and 14 faced challenges at level 1 and needed considerable guidance to complete the task. These students share a common characteristic of having limited experience with the English language; ranging from just six months to two years and none of them speak English at home. This limited exposure likely influenced their initial struggles with the reading comprehension tasks, as they may not have been fully familiar with the vocabulary or structured language encountered in the assessment at level 1. In contrast, most other students were able to manage level 3 by themselves, with two even reaching level 5 in a shorter amount of time. To support their progress, the activity was revisited after the students practiced sentence composition and text comprehension through games like Wordwall. This repetition led to better understanding of the materials and at a quicker pace, which boosted their confidence and motivation

to reach higher levels in that application. While their progress was moderate, the small improvements seen in their scores can be considered meaningful given their minimal exposure to both the English language and educational technology. Till the end of the intervention all students were able by themselves to reach minimum level 5 in one academic hour. Students such as S1, S2, S4, S5 etc. showed impressive performance in both the pre- and post-tests. They shared that S2: *"earning points or completing levels can motivate me to read and learn more on a tablet than with just a book", S1:* "*Mom and dad can't help me with tablet because we don't have at home and I don't know how to do it alone, so I enjoy it here. Home I can read books."* What distinguished Student 2 was his drive to excel in gamified tasks. He was highly motivated during competitive activities such as quizzes, where his desire to win seemed to boost his participation. This competitive edge likely contributed to his comprehension, as the fast-paced format pushed him to read quickly and accurately under pressure and focusing on the meaning of the sentences, even though English wasn't his first language. His case shows how motivation can influence understanding and enhance the effectiveness of digital interventions in general reading literacy development, however there was a negative impact on some occasions when the Internet was unavailable, the student became visibly frustrated.

It's important to mention that students were also asked to read aloud, allowing us to assess whether they were engaging with the text properly. Indeed, S16 made a note that during games like Kahoot!, she felt like reading aloud or maybe hearing the teacher read the questions aloud or the device having reading it, could provide further clarity and might help her process the information more effectively, in order to have more accurate answers. Her comment presents how auditory support can play a significant role and if we see that widely, the significance of multimodal learning environments, those that combine visual, textual and auditory inputs, as a way to support varied learning styles and improve outcomes. Portable devices appear to provide that advantage, enabling teachers to address the diverse needs of all learners.

Discussion

The outcomes confirm the research questions according to the existing literature and suggest that mobile learning environments enhanced both English reading fluency (e.g. Al Ali et al., 2024; Ahmed et al., 2022; Alharbi, 2022) and comprehension skills (e.g. Prados Sánchez et al., 2023; Nitiasih & Budiartha, 2021), as shown by differences in pre- and post-intervention test results. The intervention was most effective for students with the least English expo-

sure (0.5 to 2 years), especially from non-native backgrounds. Gender was not a major differentiator, though boys showed slightly more improvement due to initially lower scores. Country of origin and years of English learning were the most significant demographic factors influencing progress. Additionally, the findings suggest that the educational benefits of mobile learning are not solely dependent on prior digital experience or device ownership. Many students with some technological background still had an advantage but they showed progress, due to the importance of guided use, teacher support and purposeful integration of applications within lessons.

In the section where students were asked to describe what they enjoyed the most about using tablets, many emphasized that they are more entertaining and engaging tools compared to traditional books which have been already addressed in prior research (Moon, Francom & Wold, 2021; Isik, 2023). Reading progress was expected, given that the students were learning to read, yet the remarkable effect was the way tablets increased engagement. Motivation has been viewed as one of the primary determinants of student reading and understanding of the texts (Wigfield, Gladstone & Turci, 2016); pupils who are highly motivated spend more time reading, while those with low motivation often avoid reading activities (Alhamdu, 2015). In this study, the dynamic and interactive features offered, provided opportunities for students who may find conventional text overwhelming or uninteresting. For example, students who generally expressed a dislike for reading, did not report any negative experiences during the intervention and even stated that they enjoyed reading on the tablets. In a context where learning to read in English can be particularly challenging, devices provided opportunities that encouraged internal interest, pleasure and curiosity. External features also appeared to positively influence outcomes as many students reported, e.g. awards, etc. Also, the gamified aspect of certain applications gave them a sense of achievement or *"winning"* and greatly motivated them to read carefully and pay closer attention to details in the text (Zahran, 2025). The countdown timer and background music in Kahoot! and Blooket didn't distract from the questions; they reminded students of the competition.

Another essential factor that was examined was students' feedback about what they enjoyed the least while using tablets. A significant part of responses emphasized internet connectivity as a major issue. As seen in the literature, technical problems and unreliable internet access can increase learners' anxiety (Ebadi & Ashrafabadi, 2022). In this study, when the internet failed to work properly due to new infrastructure in the school, it impacted the overall

atmosphere among the students causing frustration, feelings of sadness and disappointment as some were able to progress faster in the tasks while others were delayed. Especially, the competitive element of some applications, which many pupils found motivating, became a source of disappointment during these interruptions (Salmerón et al., 2021). However, despite that challenge, the students remained eager to use the devices, with many being super motivated to continue working with them. And it is more than valuable to mention that this is one of the several challenges the research faced.

Furthermore, some instances were observed where students became distracted after completing the tasks they were supposed to (O'Toole & Kannass, 2018). Some were found engaging with other games instead of returning the tablets to adults, momentarily losing focus but this issue was promptly managed and their attention was redirected to the task at hand. On a different note, students raised concerns about the potential overuse of tablets and digital devices. They worried that frequent use might harm their eyesight, especially since they were already using screens at home. This concern points to the importance of balancing screen time and integrating non-digital activities to promote a healthy approach to technology in education (OECD, 2024). Lastly, teachers' lack of expertise can limit its effective use in the classroom. They should reflect on their digital skills and stay informed about trends in mobile technologies to provide up-to-date, empirically supported evidence. Overall, there were no major issues throughout the intervention, but one important takeaway is the need for caution regarding the specific applications used. It would be beneficial to ensure that students are familiar with the apps beforehand, particularly in terms of safety features and login procedures. For example, certain platforms might require passwords or specific app downloads, which should be communicated clearly to the students ahead of time to avoid confusion and distractions. Interestingly, about 44% of students expressed a preference for both books and tablets. They recognized that each medium offers unique advantages; books provide a sense of familiarity, while tablets make reading fun and exciting. This dual appreciation suggests that tablets did not diminish the value of books but rather complement them.

Conclusion

This study aimed to investigate how a long-term mobile learning environment influences reading fluency and comprehension skills in first graders learning English. Design-based research, using iterative cycles of implementation and analysis, was employed as an innovative approach to generate new knowledge

and develop effective educational practices in today's rapidly evolving technological world. Research on this topic, especially in elementary education, remains limited. For that reason, this study contributes to the academic literature by showing that mobile devices can positively influence students on their reading achievements in fluency and comprehension. Motivation plays a central role in this effect and methods that maximize motivation when learning to read in another language are needed. Tools such as tablets appear to support this effectively. Given these considerations, the findings raise important questions for future research: Which specific features of tablet activities most effectively support reading fluency and comprehension across diverse classrooms and student populations? Do students participate in learning activities because they genuinely enjoy them or because they are motivated by the educational value they expect to earn? How can future interventions maximize the benefits of mobile learning while minimizing potential limitations or variability in student progress? Some limitations of the methodological approach should be acknowledged. Previous research shows that pre- and post-tests can be either identical or slightly different and when different but related tests are used, there may be a greater margin of error or regression effects. Factors such as school events (history), natural development (maturation), repeated testing, changes in testing conditions (instrumentation), student absences (attrition) or naturally low starting scores (regression to the mean) may influence results (Marsden & Torgerson, 2012). Nonetheless, Direnga et al. (2017) explain that it is still possible to assess learning outcomes reliably. Many threats were minimised in this study, because students experienced the same learning environment, many educational practitioners and experts cooperated together and the intervention was delivered under consistent and supervised conditions. These controlled conditions and the use of multiple data collection tools reduce the likelihood that external factors explain the improvements observed in the post-tests. While including a control group would have strengthened the study, the composition of the participants did not allow for this. Therefore, the focus was on the individual reading development of each student before and after the intervention. In addition, measuring the long-term effects of design-based research interventions is complex, as educational outcomes may take time to materialize and external factors can interfere with results. For example, the active involvement of researchers in both the design and evaluation phases can introduce bias, as their close participation may unintentionally influence the development and assessment of the intervention, potentially compromising objectivity.

Other limitations that need to be considered as well is the relatively small sample size and participants' reading abilities were different. As a result, future research could benefit from involving a larger and more diverse sample to make the findings more widely applicable. The specific type of school where the research was conducted may have influenced the results and factors such as duration, teacher guidance, text selection and individual pacing, too. Apart from that, while this study highlights the potential of certain applications, exploring a broader range of apps, especially newer and more specialized ones, could present different and perhaps more comprehensive results. It is also essential to prepare future educators to integrate digital devices effectively into their teaching, thereby fostering students' digital literacy. With appropriate training and thoughtful implementation, tablets can serve as powerful tools for developing reading skills both in and out of the classroom. While further research is needed, particularly in primary education, to assess long-term outcomes, this study provides a valuable foundation for understanding the potential of mobile learning environments in early reading literacy development.

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