E-books vs. paper books: comparison of children's reading comprehension and Behavior

Dr. Jorge Alberto Esponda Pérez
jorge.esponda@unicach.mx
https://orcid.org/0000-0002-6821-5361
Universidad de Ciencias y Artes de Chiapas
Tuxtla Gutiérrez, Chiapas México

Dra. Reyna Esperanza Zea Gordillo
reyna.zea@unicach.mx
https://orcid.org/0000-0003-3725-3151
Universidad de Ciencias y Artes de Chiapas
Tuxtla Gutiérrez, Chiapas México

Dra. Julia María Marroquín Figueroa
julia.marroquin@unach.mx
https://orcid.org/0000-0002-2263-3365
Universidad de Ciencias y Artes de Chiapas
Tuxtla Gutiérrez, Chiapas México

ABSTRACT

People of the current generation, those born after the 1990s, are sometimes referred to as "Millennials" because of their familiarity to and comfort with technological advancements. They grow up in a world where everyone carries a minicomputer in their pocket (Zainuddin et al., 2020), and they utilize digital tools as an integral part of almost every aspect of their lives. However, studies on how digital technologies affect pupils' academic performance and motivation are still in their infancy. The purpose of this research is to explore how sixth graders' perceptions of their e-reading experiences are influenced by their use of personalized/gamified/PDF electronic reading practices at school and how that, in turn, affects their reading comprehension and motivation levels while studying English as a foreign language (EFL). Using a quasi-experimental design, this research surveys 80 Greek sixth graders from public schools on their experiences with online gaming. The study's subjects are divided into three experimental and one control groups. Each exploratory group received a prescribed reading schedule for one of the three electronic reading formats (PDF, gamified, or customized) during therapy. Contrarily, the control group was given a written guided reading schedule to adhere to. However, there was no discernible difference in the reading comprehension levels of the four groups, despite the fact that the experimental group read from a different medium than the control group did. The findings suggest that EFL students' usage of screen reading may boost their drive to read, which is promising.

Keywords: screen reading; gamification; digitized storybook reading; traditional reading; EFL students

Libros electrónicos versus libros en papel: comparación de la comprensión lectora y el comportamiento de los niños

RESUMEN

Las personas de la generación actual, aquellas nacidas después de la década de 1990, a veces se denominan "millennials" debido a su familiaridad y comodidad con los avances tecnológicos. Crecen en un mundo donde todos llevan una minicomputadora en el bolsillo (Zainuddin et al., 2020) y utilizan herramientas digitales como parte integral de casi todos los aspectos de sus vidas. Sin embargo, los estudios sobre cómo las tecnologías digitales afectan el rendimiento académico y la motivación de los alumnos aún están en pañales. El propósito de esta investigación es explorar cómo las percepciones de los estudiantes de sexto grado sobre sus experiencias de lectura electrónica se ven influenciadas por el uso de prácticas de lectura electrónica personalizada/gamificada/PDF en la escuela y cómo eso, a su vez, afecta su comprensión lectora y niveles de motivación mientras estudiar inglés como lengua extranjera (EFL). Usando un diseño cuasi-experimental, esta investigación encuesta a 80 estudiantes griegos de sexto grado de escuelas públicas sobre sus experiencias con los juegos en línea. Los sujetos del estudio se dividen en tres grupos experimentales y uno de control. Cada grupo exploratorio recibió un programa de lectura prescrito para uno de los tres formatos de lectura electrónica (PDF, gamificado o personalizado) durante la terapia. Por el contrario, al grupo de control se le dio un programa de lectura guiada por escrito para cumplir. Sin embargo, no hubo una diferencia perceptible en los niveles de comprensión de lectura de los cuatro grupos, a pesar de que el grupo experimental leyó en un medio diferente al del grupo de control. Los hallazgos sugieren que el uso de la lectura de pantalla por parte de los estudiantes de EFL puede aumentar su impulso por leer, lo cual es prometedor.

Palabras clave: *lectura de pantalla; ludificación; lectura de libros de cuentos digitalizados; lectura tradicional; estudiantes de inglés como lengua extranjera*

INTRODUCTION

The relationship between technology and education has grown more apparent in recent years. Educational technology in various settings, including business, charity, health care, and education, accelerates our learning (Lafontaine et al., 2019). Additionally, Szymkowiak et al. (2021) emphasize that when new technology enters our lives and learning settings, the nature of reading changes quickly. According to Lafontaine et al. (2019), reading is crucial in this context because (a) it is required for anyone who wants to learn a skill, (b) it enables people to keep up with recent relationships, (c) it directs the trajectories of life and ensures the participation of the general population in public education, and (d) it allows people to stay on top of the recent relationships. Teachers in this day and age who are working with students that are heavily reliant on technology unavoidably search for ways to pique their interest in reading. Educators in the digital era need to understand the potential advantages of technology-enhanced education and learning.

Language teachers have recently seen a lot of pupils who are reluctant to read in the target language (Mohamed, 2018). Since it has been shown that early children's attitude and confidence while reading affect the success of their later reading, motivating pupils to read has become vital and a difficulty that instructors often encounter, especially with adolescent students (Troyer et al., 2019). Reading comprehension is one of the most crucial skills that any student of a foreign language, especially one learning the language, must possess (Liu & Brantmeier, 2019). As readers develop their reading skills, they also develop their other language skills. Early reading attitudes and confidence have been shown to predict children's eventual reading success, as was earlier known (Troyer et al., 2019). Early reading helps kids improve their linguistic skills, which supports better academic performance (Dreger et al., 2019; Guevara et al., 2020). With the ability to deliver English language learners (EFLs) individualized versions of texts and reduce cognitive load, the goal of this research was to show that the use of customized electronic reading lessons is helpful in enhancing reading comprehension. This was accomplished utilizing customized electronic reading software and online books from the blended learning platform "Raz-Plus".

Young children read more and more on their digital devices as a result of the rising usage of digital technology in schools (Reimer et al., 2021). Therefore, it's crucial to understand

how children's reading comprehension varies depending on whether they read content on computers or in print. Few studies have looked at how children's reading comprehension is impacted by the reading medium (Halamish & Elbaz, 2020). The digitalization of international tests (PIRLS2 and PISA3) has been a significant driving force behind this work (Hwang et al., 2021). By using personalized and gamified electronic book reading to enhance sixth-year students' reading performance in a Greek EFL context, existing research on the topic will be expanded in this project.

The main goal of this research is to ascertain if customized and gamified electronic book reading in EFL sessions enhances students' motivation and reading comprehension skills. Additionally, this study aims to show if individualized, game-based e-book reading methods are viable in public schools. Finally, the researchers want to provide a manual to teachers who want to implement tailored and gamified e-book reading habits in their homes, schools, and classrooms. Parents, schools, instructors, and administrators all fall under this category.

Effects of Reading Customized Electronic Books

A child may read an electronic book that has been specifically written for them. These personalized books' main objective is to inspire youngsters to read and appreciate storytelling. Custom-fitted reading systems are often used to try to teach children new concepts or provide them with a variety of unique reading experiences (Kucirkova & Flewitt, 2020). According to Kucirkova and Flewitt (2022), exclusive e-reading features enable a variety of interactions, such as listening to the story, recording one's voice, getting immediate feedback and help when students are confused, highlighting text, using hotspots, having the text read aloud to them, and even creating one's own stories. Kucirkova and Flewitt (2022) suggest using the names of the child's friends and family members as supporting characters to better adapt the story for the young reader. By designing an avatar to play the role of the main character, for instance, students may construct their own interpretations of the story; with the aid of the electronic reading features they helped to design, children may compose meaningful and amusing stories. Individualized e-books could, however, be subject to certain limitations. Due to cognitive overload brought on by interactive elements like hotspots and games in personalized electronic books, children's understanding of the story may decrease (O'Toole & Kannass,

2018). Kucirkova and Flewitt (2020) advise against utilizing just personalized digital books with children.

The Effects of Gamified Electronic Reading

Reading e-books that have been gamified allows young readers to experience the literary world. In addition, educators have profited from gamification's capacity to foster participation. One of them is "Khan Academy", a free educational tool that provides lectures on subjects ranging from music to mathematics and employs a badge system to demonstrate topic mastery. Award programs are commonly used by teachers to promote and acknowledge success in the classroom. Publishers of textbooks also make use of gamification's benefits. For instance, the "Connect" application from McGraw-Hill Publishing provides online exercises to complement textbooks. These exercises also contain a score and a scoreboard so that students may compare their points to those of their peers or their own best. Explicit end goals, unambiguous game rules, and the development of strategies to complete the tasks are all gaming elements that help engage students in three distinct ways, as stated by Johns et al. (2018). First, gaming features may be socially stimulating by providing incentives for team members to cooperate or compete with other teams. Thus, when students get prizes and feedback while engrossed in the game's activities, academic games are emotionally gratifying. In order for these qualities to be present, the game must eventually be challenging enough to draw in youngsters without overwhelming them.

In the twenty-first century, educators must also address the issue of motivation. Toste et al. (2020) identified recognition, competition, self-efficacy, curiosity, as well as social and general reading enthusiasm as subfactors of reading motivation. Children's passion and interest in reading are reportedly increased by interactive components, which motivates children to engage in reading books, according to Lisenbee and Ford (2018). Since reading online offers a lively and interesting environment, more children are reading online. Reading is associated with the development of literacy skills, along with children's level of interest and time spent reading, as claimed by Egert et al.'s study from 2022. Additionally, several studies have shown that reading interventions may predict future success and progress in reading, and reading engagement is related to reading motivation (Verhoeven et al., 2020). Since children are more motivated at that age, it is reasonable

to infer that early reading support from parents and teachers will have a major influence on students' future reading achievement.

Research Questions

The following research questions will be addressed to be answered by this study:

Research Question 1 (RQ1): Does the desire to read printed books among EFL students in sixth grade vary significantly from that of those who have access to gamified e-books, personalized e-books, and PDF e-books?

Research Question 2 (RQ2): Does the reading comprehension of EFL students in sixth grade who read gamified e-books, personalized e-books, and PDF e-books vary significantly from those who read printed books?

METHOD

This study's main goal was to examine how reading electronic books affected sixth-grade EFL students' comprehension and reading motivation in a public school environment. A reading motivation measure with four options was employed, and reading comprehension tests were given before and after the investigation. Random sampling was not used due to design limitations. People were assigned at random into groups that resembled those that were already there based on looks. It did not establish the similarity of the two groups of persons.

Research Design

Four experimental settings were used to assess the impact of four e-book treatments. Before beginning the research, each group received two hours of instruction. They read a work of fiction chosen to facilitate the practice of various abilities, including (a) asking and answering questions on the text's most important aspects; (b) recounting a tale; (c) describing a story's characters, surroundings, and significant events; and (d) use pictures and details to depict the people, places, and events in a tale.

Gamified Reading Group ($n_1 = 20$*)*

Prior to the guided reading experiment, students received in-class instruction to improve reading fluency and comprehension. Students were given 90 minutes to listen to, read, and test on texts selected for their reading level. Each session lasted 90 minutes, and the software they utilized was called "Raz-Kids". All 20 class members needed to use the program at each meeting. All the kids had their login information, and the courseware was tailored to their individual reading abilities.

Personalized E-Book Reading Group (n_2* = 20)*

They participated in a five-week individualized reading program. It was given one-on-one, once a week, for a total of 90 minutes. Twenty pupils were obliged to use the software at all times. Each student had a unique username and password, and the interface could be fitted to their reading ability. Students were given 90 minutes to read and complete an exam on books chosen for their reading capacity. They were restricted from using the play's capabilities during these sessions. Students were taught strategies for improving their reading fluency and comprehension long before the study on guided reading was conducted.

PDF Guided Reading Program (n_3* = 20)*

Every session lasted 90 minutes, and the whole program extended over five weeks. Each of the twenty students in attendance at any given session would open their folder and read aloud from the electronic version of the book shown on the screen. Students had 90 minutes to read and take tests on books according to their reading level. During such times, they were only permitted to open the PDF file and not any other websites.

Printed Guided Reading Program (n_4* = 20)*

Each 90-minute session spread over five weeks and was given separately. Each of the 20 students received the printed book and questions from the instructor at the beginning of each class. The timer was set for 90 minutes, across which guided reading exercises were carried out and tests on the level-appropriate books were given to the pupils.

Participants and Settings

During first trimester of the 2022–2023 academic year, the research included 80 sixth-year, primary school students (N = 80) who were enrolled in four urban, state schools and equal EFL classes in the prefecture of Magnesia, Greece. The EFL program that the study's participants are exposed to consists of a four-skill integrated curriculum taught by Greek EFL instructors over the course of three weekly lessons. Additionally, students participated in a communicative skills (CS) program with a teacher who was a native English speaker for two hours each week. The experiment was conducted in-class, and each book received a weekly allotment of 90 minutes (two lesson hours). The participants ranged in age from 11 to 12. The research used public schools with at least one sixth-grade classroom that included 24 pupils. Greek EFL instructors taught each lesson, and the researchers—as educators—were also present. Even though instructors sometimes

use formative assessments, summative measures are often used to evaluate students' development. The study's participants are elementary school students who are still in their early learning stages. Their average level of English proficiency was A1+ at the time of the survey. Each, however, has a very different learning style, aptitude for apprehending a second language, and areas of interest.

Intervention Material

The following five Raz-kids novels were chosen: (a) *Brainstorm Bear*, (b) *Different*, (c) *My Bones*, (d) *If I Were in Charge*, and (e) *John's Stop Sign*. The tasks were completed by the children on their own time using a desktop computer, each child having their own headset and mouse. All of the evaluations were completed in written form, and the replies were recorded in "Microsoft Excel" spreadsheets software by the researchers.

Data Collection Instruments and Procedures

English Proficiency Test

The Cambridge Movers Sample Test was utilized for this research to determine the learners' current English proficiency level. The researchers and the seasoned EFL teachers who worked at the examined schools and taught the same kids conducted the assessment. To guarantee inter-rater reliability, the scorers collaborated to compare, justify, and negotiate their ratings after each had independently evaluated all the competence tests.

Reading Comprehension Tests

Following each narrative, reading comprehension exams were employed to gage the student's level of understanding. Reading comprehension assessments were created to compare students' apperception of the five weeks of the electronic reading course's material. The reading comprehension appraisals that were developed comprised sections for vocabulary, narrative components, issue and solution, detail analysis, major concept and detail identification, and total reading comprehension scores. Each book's level was designated employing other widely used leveling systems including Lexile, Reading Recovery, and Developmental Reading Assessment.

Reading Motivation Questionnaire

In this research, the effect of the gamified reading courses before and after the experiment was examined administering a 4-point Likert-type reading motivation questionnaire created by Toste et al. (2020). To ascertain if there had been a substantial

change in the students' motivation to read, a reading motivation questionnaire was utilized to estimate the students' motivation before and after the intervention. The questionnaire was given out by the researchers in the classrooms. Before the kids responded to the survey, it was explained to them that they should answer questions regarding their reading and that there were no right or wrong responses. Children were given the option of answering each question on a scale from 1 to 4, with options ranging from (1) "Quite different from me" to (4) "A lot like me". They were given a window of time to read the questions independently. In around seven minutes, they completed the Motivation for Reading Questionnaire (MRQ; see Table 1). The subfactors that make up reading motivation scores include recognition, competitiveness, self-efficacy, sociability, curiosity, and general reading motivation. The results of the descriptive analysis performed on the pilot research data using SPSS 22.0 to test internal consistency reliability showed that the questionnaire had good reliability, as indicated by a Cronbach's *alpha* value of .91.

Procedural sequence

To evaluate the students' levels of English ability, the researchers distributed the Cambridge Movers exam. To make sure the exam was level-appropriate for the participants, a sample test was piloted with a different sixth-grade class of 24 children. Subsequent to the completion of the piloting procedure and analysis of the data, the sample test was delivered concurrently to all four participant groups, and the analysis lasted about 65 minutes. In order to maintain a peaceful, unobtrusive atmosphere, the intervention and evaluations were conducted in class. Students read one fictitious storybook weekly as part of the intervention, which began the next week. During the intervention, kids read an e-book by themselves. Students responded to 10 reading comprehension questions after finishing each book. Both the researchers and the classroom instructors were present at all times throughout the sessions. Students completed the "Reading Motivation Questionnaire" post-test once the 5-week intervention was over.

RESULTS

Instruments geared toward quantitative data collection were used for this investigation. Students' pre- and post-test scores on the Reading Comprehension and Reading Motivation questionnaires provided the quantitative data. All of the collected

information was entered into SPSS (Statistical Package for the Social Sciences) 22.0 for Windows, where it was tabulated and subjected to statistical analysis. The Kruskal-Wallis test, Mann-Whitney U test, and Wilcoxon test were applied as pairwise comparisons in the quantitative data analysis. In contrast to the dependent t-test, which is parametric, the Wilcoxon test is non-parametric. Due to a lack of statistical power from a large sample size, non-parametric tests were employed here. Chi-square testing was executed to evaluate differences in the frequency of occurrence of descriptive characteristics between the groups. To "compare continuous quantitative data between groups", the Kruskal-Wallis test was conducted (Creswell, 2012). The Mann-Whitney U test was utilized to supplement the Kruskal-Wallis test results so as to draw conclusions about the dissimilarities. Between-group differences were statistically significant. For this study, p ≤ .05 was chosen as the threshold for statistical significance. The Wilcoxon test was used to examine the variation in the groups' repeated measurements.

Table 1. The *Motivation for Reading Questionnaire.*

Statements	Very different from me	A little different from me	A little like me	A lot like me
1. I know that I will do well in reading next year (efficacy).				
2. I am a good reader (efficacy).				
3. I learn more from reading than most students in the class (efficacy).				
4. If the teacher discusses something interesting, I might read more about it (curiosity).				
5. I like to read about new things (curiosity).				
6. I read to learn new information about topics that interest me (curiosity).				
7. I like being the only one who knows the answer to something we read (competition).				
8. I like to finish my reading before other students (competition).				
9. I need to see my name on a list of good readers (competition).				
10. I like having the teacher say I read well (recognition).				
11. My friends sometimes tell me I am a good reader (recognition).				
12. I like to get compliments on my reading (recognition).				
13. I often read to my brother or sister (social).				
14. I talk to my friends about what I am reading (social).				
15. I visit the library often with my family (social).				
16. I do as little schoolwork as possible in reading (compliance).				
17. I always do my reading work exactly as the teacher wants (compliance).				
18. I always try to finish my reading on time (compliance).				
19. I read because I have to (compliance).				

Results on the Influence of Various Reading Environments on Reading Motivation

To ascertain whether there was a difference in the reading motivation scores of the groups as a result of the various reading environments—reading printed books, reading gamified e-books, reading personalized e-books, and reading PDF e-books—a comparative analysis was conducted and the between-group statistics were tabulated. The analysis of the assessment of group differences in reading motivation may be seen in Table 2.

Students' post-self-efficacy ratings show a significant difference between the groups: 2(3) = 44,682; $p \leq .000$ / .05. The self-efficacy ratings of the participants who received tailored e-books as treatment (M = 3,605) were found to be higher than those of the individuals who received PDF e-books (M = 2,866) over the course of the study. Additionally, the individuals who received customized e-books as part of their therapy had better post-treatment self-efficacy ratings (M = 3,605) when compared to the people who were exposed to printed books (M = 2,574). Data analysis also revealed that after treatment, individuals who received gamified e-book therapy had higher post-treatment self-efficacy ratings (M = 3,470) than those who received PDF e-book exposure (M = 2,866). Moreover, the children who underwent gamified e-book therapy had higher post-treatment self-efficacy ratings (M = 3,605) than the people who received printed-book exposure (M = 2,574).

Table 2.

Examining the Group Invariance of Reading Motivation Measurement.

Groups	Personalized e-book reading group (*n* = 24		PDF e-book reading group (*n* = 24)		Gamified e-book reading group (*n* = 24)		Printed book reading group (*n* = 24)				
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*KW*	*p-value*	*D*
Pre-self-efficacy	2.806	.723	2.734	.675	2.822	.729	2.720	.633	10,747	.116[ns]	
Post-self-efficacy	3.605	.338	2.866	.708	3.470	.357	2.874	.464	44,682	.000*	1 > 2
											1 > 4
											3 > 2
											3 > 4
Pre-competition	2.916	.673	2.980	.848	2.939	.658	2.901	.000	10,878	.124[ns]	
Post competition	3.116	.673	2.980	.848	3.855	.233	2.178	.240	50,129	.000*	3 > 1
											1 > 4
											3 > 2
											2 > 4
											3 > 4
Pre curiosity	2.418	.794	2.326	.543	2.376	.712	2.368	.260	10,436	.322[ns]	
Post curiosity	2.949	.533	2.147	.484	2.928	.335	2.147	.195	55,389	.000*	1 > 2
											1 > 4
											3 > 2
											3 > 4
Pre compliance	3.014	.413	3.064	.429	3.022	.419	3.028	.424	10,883	.113[ns]	
Post compliance	3.553	.322	3.105	.777	3.022	.738	2.439	.112	33,269	.000*	1 > 3
											1 > 4
											2 > 4
											3 > 4
Pre social	2.759	.733	2.728	.598	2.770	.632	2.749	.000	10,119	.019*	
Post social	3.053	.384	3.020	.549	3.095	.483	2.814	.112	13,892	.004*	1 > 4
											2 > 4
											3 > 4
Pre recognition	3.062	.509	3.070	.492	3.070	.412	3.073	.354	10,025	.116[ns]	
Post recognition	3.362	.509	3.070	.492	3.570	.412	2.473	.354	44,025	.000*	1 > 2
											1 > 4
											3 > 2
											2 > 4
											3 > 4
Pre-general reading motivation	2.569	.269	2.589	.469	2.313	.243	2.436	.133	10,153	.233[ns]	
Post general reading motivation	3.269	.269	2.889	.469	3.313	.243	2.436	.133	51,153	.000*	1 > 2
											1 > 4
											3 > 2
											2 > 4
											3 > 4

Note. KW = Kruskal–Wallis; *p* < .05 Kruskal–Wallis *H* Test; ns = non-significant (*p* > 0.5).

Students' post-competition scores varied considerably across the groups, according to 2(3) = 50,129; $p \leq .000 / .05$. Data analysis revealed that post-competition ratings of participants exposed to gamified e-book reading ($M = 3,855$) were greater than post-competition scores of individuals who received the customized e-book reading treatment ($M = 3,116$). After the competition, individuals who read gamified e-books ($M = 3,855$) outperformed those who just read PDF e-books ($M = 2,980$), according to a comparison of their post-competition results. Individuals exposed to gamified e-book reading had higher post-competition scores ($M = 3,855$) as opposed to participants treated with paper books ($M = 2,178$). The results of comparing the post-competition marks of participants who received customized e-book reading therapy ($M = 3,116$) to participants who received printed book treatment ($M = 2,178$) show that the former group performed better. Finally, post-competition scores for participants who read PDF e-books ($M = 2,980$) were similarly higher than those for individuals who read paper books ($M = 2,178$).

Table 3. Reading comprehension descriptive statistics for the groups.

Groups	Personalized e-book reading group (n = 24		PDF e-book reading group (n = 24)		Gamified e-book reading group (n = 24)		Printed book reading group (n = 24)		KW	p-value	D
	M	SD	M	SD	M	SD	M	SD			
First-week story elements	0.829	.382	0.709	.465	0.709	.465	0.709	.465	1,446	.696ns	
Fifth-week story elements	0.579	.505	0.789	.416	0.959	.205	0.789	.416	9,833	.019*	3 > 1
First-week main idea and details	0.879	.339	0.959	.205	0.789	.416	0.709	.465	5,939	.116ns	
Fifth-week main idea and details	0.829	.382	0.829	.382	0.879	.339	0.669	.483	3,832	.279ns	
First-week problem and solution	0.919	.283	0.501	.512	0.829	.382	0.919	.283	17,000	.001*	1 > 2
											3 > 2
											4 > 2
Fifth-week problem and solution	0.749	.443	0.579	.505	0.829	.382	0.829	.382	5,279	.154ns	
First-week analyze character	0.619	.496	0.829	.382	0.669	.483	0.709	.465	2,795	.425ns	
Fifth-week analyze character	0.959	.205	0.789	.416	0.879	.339	0.879	.339	3,017	.390ns	
First-week vocabulary	0.619	.496	0.749	.443	0.669	.483	0.959	.205	8,3559	.040*	4 > 1
											4 > 2
											4 > 3
Fifth-week vocabulary	0.579	.505	1.000	.000	0.459	.510	0.959	.205	27,709	.000*	2 > 1
											4 > 1
											2 > 3
											4 > 3

Note. KW = Kruskal–Wallis; *p < .05; ns = non-significant (p > 0.5).

Students' post-curiosity ratings revealed a difference between the groups that was statistically significant [2(3) = 55,389; *p* ≤ .000 / .05]. Post curiosity scores were shown to be greater for the gamified e-book reading group (*M* = 2,949) than for the PDF e-book reading group (*M* = 2,147). What's more, it was discovered that the customized e-book reading group's post curiosity scores (*M* = 2,949) were greater than the printed book reading group's (*M* = 2,147). The gamified e-book reading group's post-curiosity marks (*M* = 2,928) were higher in contrast to those of the PDF e-book reading group's (*M* = 2,147), which was evident from the comparison. Finally, it was discovered that the post-curiosity ratings of gamified e-book reading participants (*M* = 2,928) were better than those of the printed book reading group (*M* = 2,147).

The students' post compliance ratings vary considerably across the groups, with a 2(3) = 33,269; *p* ≤ .000 / .05. The post compliance ratings of individuals who read personalized e-books (*M* = 3,553) were shown to be higher than those of participants who read gamified e-books (*M* = 3,022). When compared to the post-curiosity ratings of the individuals exposed to printed book reading (*M* = 2,439), the grades of participants who were engaged in customized e-book reading (*M* = 3,553) likewise were performed better. Both the PDF and gamified e-book reading groups' post compliance scores (*M* = 3,104 and *M* = 3,022, respectively) were found to be greater than the printed book reading group's post curiosity score (*M* = 2,439).

The students' post-social ratings varied considerably across the groups, with a difference of 2(3) = 13,892; *p* = .003 (< .05). Individuals who read customized e-books (*M* = 3,053) had higher post-social ratings than participants who read printed books (*M* = 2,814). Furthermore, it was noted that the post-social scores of the participants who read PDF and gamified e-books (*M* = 3,220 and *M* = 3,095, respectively) were both higher relative to the post-social scores of the individuals who read paper books (*M* = 2,814).

Between the groups, the students' post-recognition scores vary considerably [2(3) = 44,025; *p* ≤ .000 / .05]. Students reading gamified e-books had higher post recognition scores (*M* = 3,362) than students reading e-books in PDF (*M* = 3,070). Similarly, the customized e-book reading group had better post recognition scores (*M* = 3,362) counter to the printed book reading group (*M* = 2,473). The post recognition ratings for the gamified e-book reading group (*M* = 3,570) were also higher than the post recognition scores for the PDF e-book reading group (*M* = 3,070). The research also revealed that the

post-recognition scores of the participants who read PDF and gamified e-books (M = 3,070 and M = 3,570, respectively) were higher than the post-recognition scores of the individuals who read paper books (M = 2,473).

The students' post-general reading motivation levels also vary substantially across the groups, as shown by the following statistic: 2(3) = 51,153; $p \leq$ .000 / .05. Individuals who received customized e-book reading instruction had higher post-general reading motivation levels (M = 3,269) relative to participants who received PDF e-book reading instruction (M = 2,890). Besides that, individuals exposed to customized e-book reading had greater post-general reading motivation levels (M = 3,269) than those exposed to printed book reading (M = 2,436). Additionally, data analysis showed that gamified e-book reading participants had higher post-general reading motivation levels (M = 3,313) than PDF e-book reading participants (M = 2,889). The post-general reading motivation scores of participants who read PDF e-books (M = 2,889) and gamified e-books (M = 3,313) were both better than those of individuals who read printed books (M = 2,436).

Research on the Impact of Various Reading Environments on Reading Comprehension

A comparison study and between-group data analysis were done to see whether the variations in reading comprehension ratings were due to the four different reading environments (print book, gamified e-book, personalized e-book, and PDF e-book). This section shows how each group did in terms of reading comprehension during the experiment. Table 3 provides descriptive information for each group's level of reading comprehension.

After the first week, there was a statistically significant difference between the groups in both the problem and solution scores [(2(3) = 17.00; $p \leq$ .05]. After the first week, participants in the customized e-book reading group scored better on the problem and solution (M = 0.93 vs. pdf e-book reading group: M = 0.49). The gamified e-book reading group outperformed the PDF e-book reading group in terms of problem-solving performance during the first week (M = 0.84). The printed e-book reading group had better first-week problem-solving scores (M = 0.93) than the PDF e-book reading group (M = 0.50).

There was a statistically significant difference in the vocabulary scores of the children between the two groups in the course of the first week of school [(2(3) = 8.36; p =.03 $\leq$ .05]. Initial vocabulary scores for printed books were found to be higher (M = 0.97) than

for tailored e-books ($M = 0.63$). Scores on the first vocabulary test were greater for the group reading printed books ($M = 0.97$) than for the group reading PDF e-books ($M = 0.76$). First-week vocabulary scores for the printed book group were higher ($M = 0.97$) in distinction to those for the gamified e-book group ($M = 0.68$).

Students' Week 5 ratings on the narrative components substantially varied among groups [2(3) = 9.83; $p = .02. ≤ .05$]. Participants who read gamified e-books had higher scores on narrative components in Week 5 ($M = 0.96$) than those who read customized e-books ($M = 0.58$). The groups also showed significant differences in their Week 5 vocabulary scores [2(3) =27.69, $p ≤ .00 / .05$]. When comparing vocabulary scores across groups in Week 5, those who read PDF e-books ($M = 1.00$) and those who read printed books ($M = 0.97$) fared better up against those who read customized e-books ($M = 0.59$). Likewise, it was found that students in the PDF e-book reading group ($M = 1.00$) and the printed book reading group ($M = 0.97$) had higher vocabulary scores in Week 5 than students in the gamified e-book reading group ($M = 0.47$).

There was no statistically significant difference between groups on any of the reading comprehension subfactors evaluated (i.e., narrative components, character analysis, main idea and details, problem, and solution; $p > .05$). We found no statistically significant disparity in post-test mean scores for overall reading comprehension using the Wilcoxon test for matched groups ($p > .05$).

DISCUSSION

This research aimed to compare sixth-grade EFL students' reading comprehension and motivation across four reading formats (gamified e-books, customized e-books, PDF e-books, and printed books).

Discussion of the findings of RQ1: Is there a substantial difference in reading motivation between sixth-grade EFL students who read gamified e-books, customized e-books, or PDF e-books (experimental group) and students who read printed books (control group)?

The purpose of the first research question was to ascertain the impact of e-book reading sessions on sixth-grade EFL learners' reading comprehension skills and time spent reading. The quantitative findings showed a substantial distinctness in the post-test reading motivation survey gain ratings between the pre-test and post-test. The inclusion of personalized and gamified e-book reading sessions in particular has had a significant influence on the study participants' motivation to read. Participants in the personalized

e-book reading and gamified e-book reading courses read less than those who participated in the PDF e-book reading and printed book reading sessions. According to Egert et al. (2022), electronic storybooks are becoming more and more well-liked and work well as reading incentive tools for individuals. Student self-judgment is supported by research, and it seems to be effective for increasing student engagement and learning from digital texts (Lacka et al., 2021). Self-efficacy expectations significantly determine a person's degree and success in computer usage (Ferraro, 2018). As attested by Goosen and van Heerden (2019), students' self-efficacy may rise when they establish their learning objectives, choose their instructional resources, and actively apply them to their studies. The study's findings were in line with prior ones in that students who read personalized, gamified, and PDF e-books had higher self-efficacy scores than those in the printed book control group.

The researchers also sought to establish a relationship amongst students' motivation levels and reading proficiency in this study. In the planning stage, motivation was expected to impact reading performance, as other researchers in educational technology contend (Merga, 2021). Additionally, the hypothesis was not supported by this investigation. It was implied that this might be because of the kids' subpar performance and ability level. Due to the majority of students' weak reading performance and little variability, the prospective benefits of a gamified environment on outcomes were not readily seen (floor effect). Therefore, it can be concluded that both within and outside the classroom, learners might be encouraged to engage in more fluent and pleasant reading activities at their levels. In addition, kids might learn the techniques needed to improve their L2 and reading abilities on their own. It should be remembered, nevertheless, that some young students may not be used to reading EFL books online and may find it challenging to get interested in reading in the first place. Before implementing such an undertaking in EFL classrooms, piloting and gathering student feedback on the online EFL experience may be useful. Additionally, a dependable and consistent internet connection should be created and made available during all of the school's classes.

Discussion of the findings of RQ2: *Is there a substantial difference between the sixth-grade EFL students who read printed books (control group) and those who read gamified e-books, customized e-books, or PDF e-books (experimental group)?*

The present research also compared students' comprehension levels while reading print text and digital material (PDF e-books, customized e-books, and gamified e-books). EFL sixth-graders from elementary schools made up the participants. The three student groupings read five short tales on a digital platform, while a fourth class did it on paper. The effects of the kind of text on comprehension scores were examined using the data gathered and analyzed. The results indicated that kids' test scores were not higher regardless of whether they read print or digital material. In other words, the scores between the groups did not vary statistically significantly. The results are consistent with several earlier research that indicated no variation in the impact of various reading mediums on comprehension scores (Kong et al., 2018).

The findings of the reading comprehension test revealed that participants who read personalized and gamified e-books saw the biggest gains and significantly outperformed those in the other two groups (i.e., reading PDF e-books and reading printed books) in vocabulary questions. For the 17 times that they needed vocabulary assistance, none of the kids sought it out from their teachers (Støle et al., 2020). It's possible that students who read books in print received the same vocabulary assistance from their instructors; they came to the conclusion that e-books allow for more privacy than paper books, which force pupils to ask the teachers out loud for assistance. When students approach the instructors for help, they must take a break from the book, which might reduce their understanding of the material. E-books may greatly help youngsters understand a word's meaning by being included in a virtual dictionary (Liman Kaban & Karadeniz, 2021).

Students who have access to e-book programs and websites may download books quickly and begin reading them at their own pace. Withal, even if they are unable to understand any of the languages, kids will choose to keep reading if they are hesitant to ask for help; it is safer for a student to keep reading without comprehending than to fail in front of others (Støle et al., 2020).

Limitations, Conclusions, and Future Research

The current study is anticipated to have a number of useful ramifications for academics, practitioners, and course and material designers. The results first illustrated that electronic reading sessions might greatly enhance the learners' reading comprehension abilities and advance their language learning (LA). Apart from that, the acquired data clarified instructors' perspectives on the use of electronic reading, in conjunction with

the opinions of Greek EFL learners in sixth grade who were exposed to it. Intending to improve reading and language abilities and achieve LA via reading, learners and instructors emphasized the need for implementation. They also noted that greater peer cooperation and less instructor assistance in reading activities resulted in a more favorable experience and engagement. Due to this, it would be beneficial to include electronic reading lessons into EFL curricula to aid in the growth of language and reading abilities, as well as the accomplishment of LA via L2 reading.

The results demonstrate scientifically that personalized e-books and gamified e-books serve as unique resources that are much more effective than printed books, in addition to being an alternative to reading printed books. Hence, using well-designed digital books in the classroom and at home need to be regarded as best practice. The personalization and gamification of digital books have also been evidenced to significantly improve young children's early text comprehension, which is essential for developing more advanced reading skills (Kucirkova, 2022). The present study's results have quickly shown that screen reading lessons may be seen as an effective teaching strategy to promote the growth of reading comprehension skills and improve the reading performance and motivation of LA in EFL classrooms.

Since sixth graders are at a turning point in the development of their reading skills, they were chosen as the study's sample population. Many pupils have often mastered word recognition at this age to become fluent in everyday situations. Students are now learning how to read for enjoyment and critical analysis at this grade level (Kim et al., 2018). For more research, the current study makes several recommendations. More specifically, the survey had a small sample size (N = 80) and weak reading skills among its participants. A larger sample with a range of skill levels may also be advisable for future studies. The study has a small sample size because of its specific, preliminary nature; the generalizability of this kind of study should be improved by doing it on a wider scale. Since the statistical study's results indicated a stronger upward trend in improving student reading comprehension than students reading traditional books, it would be required to continue researching effective applications of e-books in the classroom. Another drawback of this study is that ten courses were presented each week throughout its five-week period. Devoid of a retention test, the researchers did not conduct such a follow-up study. For further studies to assess the impact of the implementation on the

participants' retention, a retention test might be conducted after a longer length of time. Lastly, the participants in this study only used reading materials from "Raz-Plus", a single online resource (www.raz-plus.com). A wider range of genre options might be provided for the students' benefit by including other book sources in screen reading courses.

REFERENCES

Dreger, S., Schüle, S. A., Hilz, L. K., & Bolte, G. (2019). Social inequalities in environmental noise exposure: A review of evidence in the WHO European Region. *International Journal of Environmental Research and Public Health*, *16*(6), 1011. https://doi.org/10.3390/ijerph16061011

Egert, F., Cordes, A. K., & Hartig, F. (2022). Can e-books foster child language? Meta-analysis on the effectiveness of e-book interventions in early childhood education and care. *Educational Research Review, 37,* 100472. https://doi.org/10.1016/j.edurev.2022.100472

Ferraro, S. (2018). Is information and communication technology satisfying educational needs at school? *Computers & Education*, *122*, 194-204. https://doi.org/10.1016/j.compedu.2018.04.002

Goosen, L., & van Heerden, D. (2019). Student support for information and communication technology modules in open distance environments: towards self-directed learning. In M. M. van Wyk (Ed.), *Student Support Toward Self-Directed Learning in Open and Distributed Environments* (pp. 26-58). IGI Global. https://doi.org/10.4018/978-1-5225-9316-4.ch002

Guevara, J. P., Erkoboni, D., Gerdes, M., Winston, S., Sands, D., Rogers, K., ... & Mendelsohn, A. L. (2020). Effects of early literacy promotion on child language development and home reading environment: A randomized controlled trial. *The Journal of Pediatrics: X*, *2*, 100020. https://doi.org/10.1016/j.ympdx.2020.100020

Halamish, V., & Elbaz, E. (2020). Children's reading comprehension and metacomprehension on screen versus on paper. *Computers & Education*, *145*, 103737. https://doi.org/10.1016/j.compedu.2019.103737

Hwang, G. J., Wang, S. Y., & Lai, C. L. (2021). Effects of a social regulation-based online learning framework on students' learning achievements and behaviors in mathematics. *Computers & Education*, *160*, 104031. https://doi.org/10.1016/j.compedu.2020.104031

Johns, J. D., Hayes, A., Grant, L., & Caldwell, D. (2018). Classroom gamification: Merging game design theory and behavior analysis for increased engagement. In P. Zaphiris & A. Ioannou (Eds.), *Learning and Collaboration Technologies—Lecture Notes in Computer Science* (Vol. 10925, pp. 150-163). Springer. https://doi.org/10.1007/978-3-319-91152-6_12

Kim, Y. S. G., Petscher, Y., Wanzek, J., & Al Otaiba, S. (2018). Relations between reading and writing: A longitudinal examination from grades 3 to 6. *Reading and writing*, *31*(7), 1591-1618. https://doi.org/10.1007/s11145-018-9855-4

Kong, Y., Seo, Y. S., & Zhai, L. (2018). Comparison of reading performance on screen and on paper: A meta-analysis. *Computers & Education*, *123*, 138-149. https://doi.org/10.1016/j.compedu.2018.05.005

Kucirkova, N. (2022). Children's agency and reading with story-apps: Considerations of design, behavioural and social dimensions. *Qualitative Research in Psychology*, *19*(1), 66-90. https://doi.org/10.1080/14780887.2018.1545065

Kucirkova, N., & Flewitt, R. (2020). The future-gazing potential of digital personalization in young children's reading: views from education professionals and app designers. *Early Child Development and Care*, *190*(2), 135-149. https://doi.org/10.1080/03004430.2018.1458718

Kucirkova, N., & Flewitt, R. (2022). Understanding parents' conflicting beliefs about children's digital book reading. *Journal of Early Childhood Literacy, 22*(2), 157-181. https://doi.org/10.1177%2F1468798420930361

Lacka, E., Wong, T. C., & Haddoud, M. Y. (2021). Can digital technologies improve students' efficiency? Exploring the role of Virtual Learning Environment and Social Media use in Higher Education. *Computers & Education, 163,* 104099. https://doi.org/10.1016/j.compedu.2020.104099

Lafontaine, D., Dupont, V., Jaegers, D., & Schillings, P. (2019). Self-concept in reading: Factor structure, cross-cultural invariance and relationships with reading achievement in an international context (PIRLS 2011). *Studies in Educational Evaluation, 60,* 78-89. https://doi.org/10.1016/j.stueduc.2018.11.005

Liman Kaban, A., & Karadeniz, S. (2021). Children's reading comprehension and motivation on screen versus on paper. *SAGE Open*, *11*(1), 2158244020988849. https://doi.org/10.1177%2F2158244020988849

Lisenbee, P. S., & Ford, C. M. (2018). Engaging students in traditional and digital storytelling to make connections between pedagogy and children's experiences. *Early Childhood Education Journal*, *46*(1), 129-139. https://doi.org/10.1007/s10643-017-0846-x

Liu, H., & Brantmeier, C. (2019). "I know English": Self-assessment of foreign language reading and writing abilities among young Chinese learners of English. *System*, *80*, 60-72. https://doi.org/10.1016/j.system.2018.10.013

Merga, M. K. (2021). How can Booktok on TikTok inform readers' advisory services for young people? *Library & Information Science Research*, *43*(2), 101091. https://doi.org/10.1016/j.lisr.2021.101091

Mohamed, A. A. (2018). Exposure frequency in L2 reading: An eye-movement perspective of incidental vocabulary learning. *Studies in Second Language Acquisition*, *40*(2), 269-293. https://doi.org/10.1017/S0272263117000092

O'Toole, K. J., & Kannass, K. N. (2018). Emergent literacy in print and electronic contexts: The influence of book type, narration source, and attention. *Journal of Experimental Child Psychology*, *173*, 100-115. https://doi.org/10.1016/j.jecp.2018.03.013

Reimer, D., Smith, E., Andersen, I. G., & Sortkær, B. (2021). What happens when schools shut down? Investigating inequality in students' reading behavior during Covid-19 in Denmark. *Research in Social Stratification and Mobility*, *71*, 100568. https://doi.org/10.1016/j.rssm.2020.100568

Støle, H., Mangen, A., & Schwippert, K. (2020). Assessing children's reading comprehension on paper and screen: A mode-effect study. *Computers & Education*, *151*, 103861. https://doi.org/10.1016/j.compedu.2020.103861

Szymkowiak, A., Melović, B., Dabić, M., Jeganathan, K., & Kundi, G. S. (2021). Information technology and Gen Z: The role of teachers, the internet, and technology in the education of young people. *Technology in Society*, *65*, 101565. https://doi.org/10.1016/j.techsoc.2021.101565

Toste, J. R., Didion, L., Peng, P., Filderman, M. J., & McClelland, A. M. (2020). A meta-analytic review of the relations between motivation and reading achievement for K–12 students. *Review of Educational Research*, *90*(3), 420-456. https://doi.org/10.3102%2F0034654320919352

Troyer, M., Kim, J. S., Hale, E., Wantchekon, K. A., & Armstrong, C. (2019). Relations among intrinsic and extrinsic reading motivation, reading amount, and comprehension: A conceptual replication. *Reading and Writing*, *32*(5), 1197-1218. https://doi.org/10.1007/s11145-018-9907-9

Verhoeven, L., Voeten, M., van Setten, E., & Segers, E. (2020). Computer-supported early literacy intervention effects in preschool and kindergarten: A meta-analysis. *Educational Research Review*, *30*, 100325. https://doi.org/10.1016/j.edurev.2020.100325

Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. *Educational Research Review*, *30*, 100326. https://doi.org/10.1016/j.edurev.2020.100326