On Digital Game-Based Reading Strategy Training: Implications for L2 Reading Ability Development

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Abstract

This article summarizes the results of an experiment that examined the effects, if any, of a digital educational game called *Into the Book*[1] on the learning of the L2 reading strategies and in turn on the L2 reading ability development of English as a Foreign Language (EFL) learners. To this aim, the experimental group practiced and applied eight common reading strategies to the reading of English passages while playing the game. Chief among them was the summarizing strategy that required the learners to watch cartoon characters narrating a story. They then chose and dragged the main ideas into a virtual box popping up on the screen. The visualizing strategy, on the other hand, required them to use stationary tools by which they could draw mental maps that would eventually help them understand the link between key events as they read the texts. The other strategies likewise required the participants to interact with different objects in the game to be able to successfully serve the reading objectives. The control group, however, received treatment on the same strategies via a conventional, teacher-fronted method. The findings showed that the mean difference was in favor of the participants in the experimental group. This carries several main implications for teachers and courseware designers.

Keywords: Digital Game-Based Learning (DGBL), Digital Game-Based Reading Strategy Training (DGBRST), EFL learners, L2 reading ability development

Introduction

In the 21st century, technology is becoming a trend in classrooms. Teachers may not be familiar with what effects technology may have on students' literacy skills development. Over the past decade, research has illustrated how computer technology supports meaningful educational experiences. Although face-to-face classroom instruction is still very popular in many organizational and educational settings, there is a rush of enthusiasm for computer-based and computer-supported instruction, given the fact that recent technological breakthrough has marked a major milestone in revolutionizing pedagogy (Farrokhnia et al., 2019). One area that has witnessed great advancements over recent years is the field of computer technology. Such breakthroughs have brought about innovative uses for computers in education, in general, and in second/foreign language instruction, in particular (Hooshyar et al., 2021).

One core aspect of second/foreign language teaching is the development of the literacy skills that enable learners to receive and also produce knowledge of the language across a diverse range of socio-pragmatic contexts of use (Deane & Song, 2014). Among the literacy skills, however, harnessing the reading ability has always presented learners with a daunting challenge: As suggested by the *Simple View of Reading* (SVR) model, reading ability

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[1] https://reading.ecb.org/student/index.html?login=

development involves gaining mastery in four distinct skills, namely raising phonemic awareness, decoding phonics (pseudoword decoding), developing word knowledge, and activating prior knowledge (schemata) as part of a higher-order comprehension skill, which accounts for a large amount of variability in learners' L2 text comprehension (Sparks, 2019).

In addition to these cognitive factors posing a serious challenge to language learners when developing their reading skills, there could be ecological (Cadima et al., 2010) and psychological (Undheim & Sund, 2008) covariates serving as potential sources of reading difficulty for learners at different stages of linguistic development. As for psychological/neurological factors, some individuals suffer from autism, attention deficit hyperactivity disorder (ADHD), dyslexia, hearing impairment, broad cognitive delays, and so on (Eklund et al., 2018; Lin, 2014). As for ecological factors, minimal exposure to L2 input, mother-tongue interference (sequential bilinguals), poor teaching methods, lack of awareness of good reading strategies, text difficulty, and so on have been cited by many as predictors of reading difficulty (Cartwright et al., 2017; Obiegbu, 2018).

A growing body of research has shown that there is a continuum on which reading ability and reading difficulties occur. It has been suggested that poor and proficient readers are likely to hold their relative positions on this continuum as time goes by (Kwiatkowska-White et al., 2016). Learners experiencing high levels of reading difficulty keep struggling in reading as they progress, which shows that some reading difficulties could represent chronic conditions that are persistent over time (McArthur & Castles, 2017).

Accurate and fluent decoding of words is among the problems that persist throughout the school years, substantially impairing learners' academic performance. The consensus is that difficulty in processing the phonological structure of language correlates greatly with reading problems, albeit whether this represents a core problem (Vellutino et al., 2004) or is per se a consequence of more basic abilities being disrupted (Goswami, 2009) is yet to be found. Convictions are strong that digital games engage learners in solving puzzles and hence can help poor and slow readers to keep up by boosting their ability to map sounds to letters, identify the graphemes, segment syllables, and recognize word boundaries while allowing them to take greater control over the pace of learning (Ronimus et al., 2019).

Among the solutions offered to obviate the reading failure of language learners, adequate investment in the teaching and implementation of appropriate reading strategies has proved to be the most successful panacea as per what is shown by the findings of many experiments (Muijselaar & de Jong, 2015; Wang, 2016). With the advent of a plethora of technological tools, there is also a rush of enthusiasm for the use of computer-based training in education whose development has gained unprecedented momentum over recent decades (Ponce et al., 2013; Sung et al., 2008).

A special type of computer-based training requires the use of an educational game or a gamified activity that seeks to present the teaching material in the form of edutainment media mingled with fun, enthusiasm, and passion (de la Pena et al., 2021). Educational games have clearly defined learning objectives, and whereas most games (e.g., real-life simulators such as SIMS, Second Life, Call of Duty, etc.) have targeted learning achievements, very few, if any, have focused on teaching the strategies required for the achievement of learning outcomes (Gorgen et al., 2020). This raises the question of how well and not how much you achieve when playing games, which warrants closer inspection.

Drawing on the constructivist theory of learning, Digital Game-Based Learning (DGBL) is claimed to integrate educational material with video games that can be tailored for teaching a wide array of skills and be used in almost all disciplines. Advocates of DGBL (e.g., Chee, 2016; Plass et al., 2015; Van Eck, 2010) contend that it provides opportunities for students to interact with instruction, preparing them for participation in the globalized, technological society. Activities involved in DGBL range in type from completing very simple

tasks to developing complex skills employed in problem-solving tasks. This partly depends on the game genre, and in one taxonomy, we may think of fighting, action-adventure, role-playing, puzzle, strategy, and sports games (Mol et al., 2021).

Coffey (2017) suggests the following points be taken into consideration when it comes to the selection of games for students: learners' characteristics, such as competitiveness and prior gaming experience; the game's age level; special needs as is the case with students with disabilities; racial and gender diversity in terms of choice of characters, situations, or language; the number of students simultaneously playing the game; and the role of the teacher, who can be an observer, a passive, or an active participant.

Yet, what is not clear from research findings is the cause of the association between playing games and academic success. There is a great consensus that learners who are gifted in math, science, reading, and many other fields are more likely to play online games. Alternatively, it could be argued that high proficiency students work more efficiently and can better manage their time playing games, making games an indicator of possible academic ability rather than something that actively boosts performance (von der Heiden et al., 2019). Some evidence suggests that video games can help build or reinforce important skills such as *spatial visualization ability* (i.e., the ability to mentally rotate and manipulate two- and three-dimensional objects). Video games have also proved effective for children who started language learning with relatively poor skills. Likewise, it has been suggested that video games can prove beneficial in balancing individual differences when it comes to spatial skill performance. Researchers also have been using video games as a means of researching individuals. All these reasons provide an insight as to why they can be pedagogically useful (Granic et al, 2014).

Literature Review

Concerning the pedagogical and psychological benefits of educational games, a great many studies have unanimously corroborated the view that digital game-based instruction holds great promise for promoting students' autonomy, motivation, and heuristic, self-regulated learning. In a seminal study, for example, Mulder et al. (2021) sought to examine whether and how the seventh graders' word-to-text integration (WTI) ability could be mediated by digital game-based instruction that aimed to improve their reading comprehension of L2 texts. This ability is indispensable to deep comprehension of L2 texts, as it requires readers to map words onto a mental representation of the text, which poses a daunting challenge to beginning readers. The intervention program comprised a 12-week game-based training period that required the participants to play four digital games targeting the development of their morphosyntactic awareness, their ability to translate words in sentences, their ability to recognize idioms from words in contexts, as well as their dictation ability (p. 1).

The participants completed reading comprehension tasks once at the beginning (T1) and once at the end (T2) of the school year. The results of a MANOVA revealed that both good and poor readers made considerable progress throughout the experiment, even though learners with higher scores on the pre-intervention measures of the reading ability (T1) showed greater progress in both in-game performance and post-intervention (T2) measures. Chief among the reasons for the great intervention effect of the games used in the study are the facts that digital games serve as mediation tools, helping learners capitalize on the semantic properties of the primes in the sentences that surround the unknown words, which in turn proves useful in anomaly processing, correct mapping of words unto mental representations, and ultimately, a deep comprehension of the text.

Saputra Komalaa and Rifai (2021) likewise examined the possible affordances of a self-authored educational game called *The Cherry Orchard* on the reading comprehension ability of EFL learners. The game narrated a story by Anton Chekov, and the participants were required to play the roles of the characters in the story to be able to comprehend the plot through multimodal texts. The students were provided with both written and auditory texts, as the characters' speech appeared in bubble texts, too. Both reading comprehension tests and questionnaires were used to gauge the participants' progress and pull their opinions about the utility of the game. The experiment showed that despite the great cognitive benefits of the game, many students found the game to be too long and monotonous. Whereas multimodal presentation of the story content (i.e., video, audio, textual information, etc.) could greatly aid in the comprehension of the text and the story as a whole, the study implied that video games need to be short in length, should offer a voice-over feature, and should promote learners' sense of accomplishment to help them stay motivated.

In a study by Ronimus et al. (2019), the effect of a digital game called *GraphoLearn* was investigated among second graders who had difficulties with the acquisition of fluent and accurate reading skills. The participants were assigned to two groups in a 6-week intervention program. One group was required to play the game while receiving school-provided support. The other group was assigned to receive the routine, everyday traditional classroom instruction and was only supported by their parents and teachers. The results of the reading tests and reports by the parents and teachers unanimously favored the game-based training program and showed that higher cognitive and emotional engagement of students in the experimental group accounted for their higher gains in word and sentence reading fluency, suggesting that training of sound-letter mapping and word-level reading can greatly improve the reading ability development of struggling readers.

Wu and Huang (2017), in a similar vein, examined the effects of a game-based vocabulary practice game on students' motivation, L2 vocabulary learning, and also their reading comprehension ability. The gaming procedure comprised the selection of words based on the content of the reading passages, a difficulty ratio used in the selection process, as well as a learning portfolio analysis. At first, the game would automatically choose a random set of words or sentences from a pool of select articles and passages. Learners could then review and memorize the vocabulary items they encountered while playing the game. The difficulty-setting tool in the game would tailor the difficulty level of the texts to the ability level of the students by deciding on the frequency with features vocabulary items and sentences showed up in the passages. Analysis of the learning portfolios would allow the system to extract the students' learning records from the past and adjust the difficulty ratio based on the estimated ability level of the participants. Analysis of the pre-and-post-intervention measures suggested that students who played the game displayed higher learning motivation, engagement, learning effectiveness concerning their L2 vocabulary command and reading comprehension ability, as well as a strong sense of triumph.

In an attempt to investigate the potential utility of digital games for elementary school students, Hofmann (2021) examined whether the use of an app-based game could aid in heightening learners' phonological awareness and improving their comprehension of words any better than traditional classroom practices. A secondary objective was to ascertain whether and how game-based instruction could privilege low achievers. The participants in four groups were assigned to receive instruction on their reading ability from either their teacher or the application. The study showed that game-based instruction holds great promise for poor readers to develop a high level of synthesis ability for phonological processing, even though the findings offered no solid evidence suggesting that game-based instruction is generally more superior to conventional approaches. A replication of the study, as the author noted, is required

to shed more light on the overall utility of game-based instruction for elementary school students.

In an interesting study, Yang and Chen (2021) sought to examine whether and how the employment of a special type of learning strategy called "prediction-observation-explanation" (p. 1) could moderate the effects of game-based instruction on students' motivation and long-term retention of the learning material. Their gaming system came with a strategy-training module that would walk learners through the steps involved in the learning tasks, providing them with detailed guidance and constructive feedback to improve their retention of the material taught. Capitalizing on a quasi-experimental design, the authors examined the efficiency of the method. Analysis of the findings revealed that both students' learning achievement and retention ability improved greatly thanks to the moderating effect of learning strategy training. The implication is that, when combined with investment in useful learning strategies, the enjoyable learning experience gained through playing educational games offers the potential both to sustain learners' motivation and to enhance their retention of the learning content.

Similarly, in an interesting study by Raynolds and Kao (2021), the interaction effect of language-focused instruction as delivered through two modalities (i.e., teacher-fronted and game-based) and follow-up error correction was examined on students' learning of English articles. The participants in the two experimental groups received instruction on the correct use of the L2 articles from the teacher or a digital game. Their counterparts under the controlled condition received no instruction but corrections on their errors. Scores on the immediate posttest showed that teacher-fronted focused instruction coupled with error correction proved more effective in furthering the learners' command of English articles. Yet, the mean difference on the delayed posttest suggested that game-based instruction featuring "just-in-time" (p. 476) corrective feedback may prove more effective in raising students' awareness of salient grammatical features, which ultimately results in longer retention of the L2 grammatical knowledge, compared to a conventional method providing delayed feedback to learners.

Aims of the Study

Whereas the findings of many studies have shown wide recognition for the affordances of digital games in language learning, in general, and reading ability development, in particular, little research exists as to whether and how teaching reading strategies through digital games could equally prove fruitful and hence warrants further scrutiny. Given a paucity of research on digital games aiming to walk learners through stages of linguistic development, emphasizing the learning process than the product of learning, the present study reports on the findings of an experiment that sought to examine the contributions, if any, of an educational game called *Into the Book* to the learning of English reading strategies, and hopefully, the L2 reading ability development of Iranian EFL learners.

The game featured modules that would engage learners in doing pedagogic tasks aiming to familiarize them with strategies for effective comprehension of L2 texts in a stepwise fashion. The overriding objective was to ascertain whether Digital Game-Based Reading Strategy Training (DGBRST) would privilege L2 learners any better than a conventional, teacher-fronted method of instruction. In line with this overarching aim, the following research question is formulated:

Q: Do DGBRST and teacher-fronted instruction produce differential effects, considered to be statistically significant, on the L2 reading ability development of Iranian EFL learners?

Method

Participants and the Setting

The participants comprised 55 sophomores who were studying EFL at an Iranian university. They were all native Iranian students who formed a homogeneous sample of EFL learners in terms of ethnicity. The participants were first recruited by using the availability sampling technique. Next, the final pool was recruited based on the score they received on a standardized test of language proficiency. Based on the participants' scores, 30 qualified candidates who obtained a score of 39 and beyond on the test were identified as intermediate learners and were ultimately allowed to take part in the main study. Intermediate learners were selected, as it was thought they would be more suitable for this study: They are not equipped with an immense wealth of vocabulary knowledge and great reading ability, but they are proficient enough to follow on-screen instruction and understand less complicated texts, a precondition for the game used in the present study. The participants were then randomly assigned into two equivalent groups of learners with the help of a digital randomizing tool called *SuperCool Random Number Generator*. The study groups also consisted of a balanced mix of learners in terms of number, each comprising 15 students (9 males and 6 females in the experimental and 5 males and 10 females in the control groups). Participation in the study was voluntary, and prospective participants would receive monetary rewards. The participants were assured that their participation would not incur physical or psychological harm to them; accordingly, their verbal confirmation was taken as a good indication that they would willingly take part in the study. The Pretest-Posttest Equivalent Groups research design was also employed to study the possible contributions of DGBRST to students' reading ability development.

Instruments

The Solutions Placement Test

A sample copy of this standard test of language proficiency was administered to the initial pool of EFL learners in an attempt to recruit a homogenous sample of participants. The test consists of three modules: The first module consists of 50 multiple-choice items that measure the learners' command of English vocabulary and grammar. The second module comprised a reading passage with 10 graded comprehension questions that should be answered in a binary format (i.e., True or False?). The third module involves an optional writing task that measures the learners' productive ability. As per the test manual, learners who manage to obtain 31 and beyond on the grammar and vocabulary test and 8 and beyond on the reading test could be identified as intermediate learners. Accordingly, 39 was the least minimum criterion score used for the selection of the participants in this study.

SuperCool Random Number Generator[2]

This is a digital randomizer that features the capability to choose a random set of numbers from within a specified range. To fairly assign the qualified participants to two study groups that were equal in numbers, each student in the final pool of the participants, which consisted of 30 learners, received a number that ranged from one to 30. These numbers were then entered into the randomizer main interface, and the program was set to produce two

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columns of randomized numbers. It was stipulated that the first 15 students whose numbers fell in the first column would be assigned to the experimental group, and all those whose numbers fell in the second column would be assigned to the control group.

The Reading Texts

Units of two well-known textbooks of L2 reading were selected as the base teaching material in this study. The passages were taken from *Cover to Cover 3 Student Book: Reading Comprehension and Fluency* (Day & Ono, 2008) and *Developing Reading Skills: Intermediate* (Markstein & Hirasawa, 1981). Twelve extra passages from these two books were also preserved to serve as the content of the pretest and posttest of L2 reading ability (six texts to be included in the pretest and six passages to be incorporated into the posttest).

The Pretest and Posttest of L2 Reading Comprehension Ability

To gauge the participants' level of reading ability before and after their receiving treatment on L2 reading strategies, two multiple-choice tests of L2 reading were developed. Each test comprised six reading texts that were selected from the reading sources just outlined. Each text was followed by five comprehension questions; therefore, the maximum possible score on each measure of the reading ability was 30. The two tests underwent standardization in a pilot study with a different constellation of intermediate EFL learners. A Cronbach's alpha was used to report on the reliability coefficients of the two measures, which turned out to be 0.85 and 0.89 for the pretest and posttest, respectively. Item statistics were calculated with the help of an electronic item statistics analyzer called *Test Analysis Program*[3]. The application features the caliber to use an asterisk in marking defective items, that is, items whose item facility (IF) and item discrimination (ID) indices are not within the desirable ranges ($0.37 \leq$ IF ≤ 0.63 & ID ≥ 0.40). An Exploratory Factor Analysis (EFA) was performed as part of construct validation. The *Principal Components* extraction technique was employed to extract all hypothetical factors with *eigenvalues* well above unity.

Into the Book[4]

This is an online educational game that features eight modules each targeting the teaching of one effective reading strategy to students through gamified activities. Contrary to average commercial games with limited quests and objectives that should be sought linearly, the objectives set by *Into the Book* would require learners to move back and forth between different stages in a cyclical and stepwise manner, allowing them to exercise greater control over the rate of delivery, amount of instruction, and also over the pace of their learning.

Data Collection

In the beginning, the participants in both study groups sat for a pretest of L2 comprehension ability. The purpose of pretesting was twofold: to gauge learners' level of reading comprehension before the experiment and to ensure the homoscedasticity of the study groups in terms of their reading ability. The study groups then received training on eight famous reading strategies under one of two conditions: The experimental group entered the researcher's private institute hosting computer terminals and wore headsets. The institute was

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[3] http://www.ohio.edu/people/brooksg/downloads/tap.exe
[4] https://reading.ecb.org/student/index.html?login=

equipped with 30 computer terminals installed inside cabins featuring acoustic walls. To ease participation, the students could negotiate with the researcher on a convenient time at which they could attend the training sessions. Likewise, care was taken so that learners of different groups could not meet one another. This could help minimize the information leakage and also help dismiss the possibility for *history effect* damaging the credibility of findings. The privacy of the participants was protected by ensuring that their performance data would not be shared with the public.

Next, once accessed the game link, all the participants started playing the game at the researcher's signal. In each session, one reading strategy was introduced to the participants. The game would first introduce the strategy to the learners, then it would supply them with examples illustrating how to apply the strategy to the comprehension of L2 texts. Following the orientation session, the participants were given a sample passage to analyze, and their successful implementation of the strategy would be rewarded by the game. The following are the strategies introduced by the game in the treatment sessions. A total of eight strategies were introduced, and each treatment session was devoted to teaching one reading strategy only.

The Summarizing Strategy

When applying this strategy, the user selects, listens, and reads a tale, story, anecdote, and so on. Next, he needs to drag the gist or the main idea into a dedicated field, akin to a sail shown on a canvas in the background. The user chooses the main idea and drags it to a yardarm. He then chooses only a select few details and drags them to a sail. Finally, he uses his notes to write a summary in his own words. Figure 1 illustrates how this strategy can be applied to the comprehension of L2 texts.

Figure 1
The Summarizing Strategy
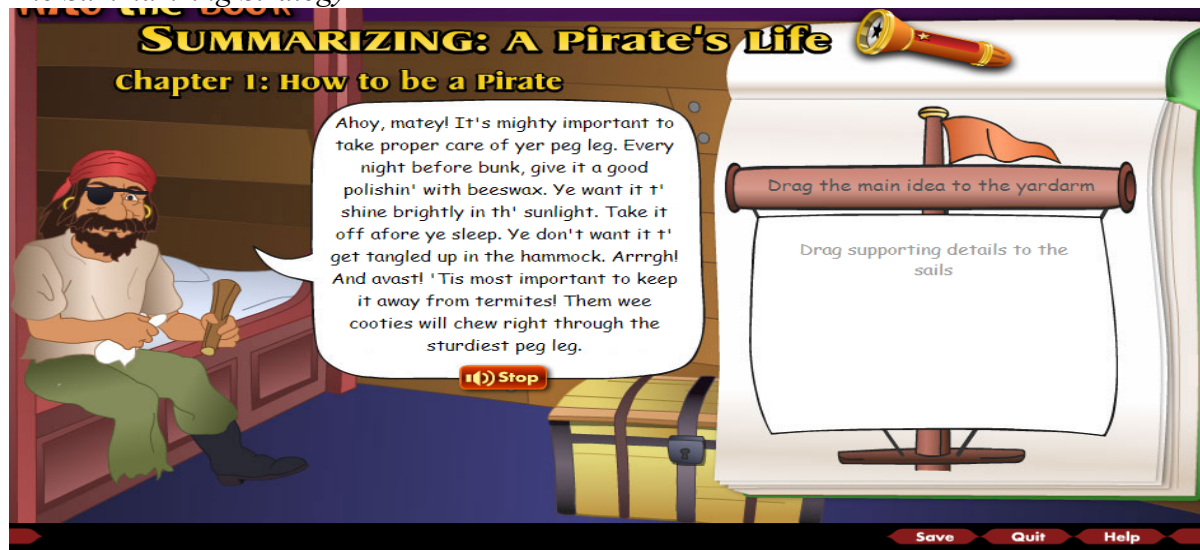
The Visualizing Strategy

Here the player uses drawing tools to visualize the events in the story as he continues reading it. The player can use music to represent individual events. He can choose texts of different genres (e.g., fiction, non-fiction, math story problem, voicemail, etc.). It is much like creating a mind movie: The player tries to see, hear, feel, or even smell what is going on. Figure 2 shows how this strategy can be employed.

Figure 2
The Visualizing Strategy

The Questioning Strategy

To find and focus learners' attention on important details in the text, they may ask questions like "Why?", "What if?", and "I wonder…" before, during, and at the end of reading a story and answer them, accordingly. For example, they walk into a castle and ask and answer questions about the events happening. They read part of a story, then they type in their questions. In so doing, an unlock key is given to the learners so they can use it to keep the story going. As they ask and answer questions, they pay close heed to different bits of information. It is akin to scanning the text for important details. Figure 3 shows how this strategy can be used in text comprehension.

Figure 3
The Questioning Strategy
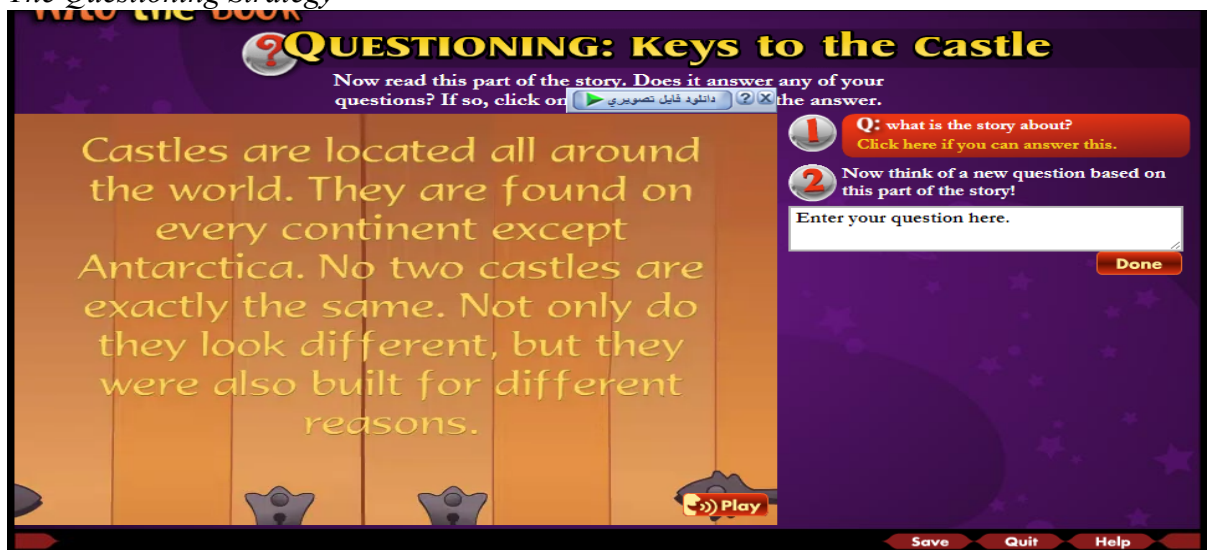
The Inferencing Strategy

Here the player uses clues in the text and things from his mind to surmise the intentions of the author. As he moves the big magnifier over the key sentences in the text, they turn yellow, allowing the player to choose from a repository of premade inferences in the next step. This strategy is sometimes called *reading between the lines*. Figure 4 illustrates how this strategy can be employed.

Figure 4
The Inferencing Strategy

The Evaluation Strategy

When applying this strategy, learners make judgments about the usefulness of the information given in the text, isolating key points from the redundant bits. For example, they analyze four sources of information (i.e., an atlas, a textbook, a graphic novel, or a journal) in their voyage to the Solar System and decide on the utility of the information they supply them with. Figure 5 shows how we can apply this strategy to the comprehension of text.

Figure 5
The Evaluation Strategy

### The Connection-Making Strategy

Here the user forms several connections between the ideas that were given in the text by linking the events in the story to his personal life or other related information. It is like building a bridge between different fragments of ideas that would make a whole. For example, he sees a mini-game titled *The Mountain of Understanding*. Next, as the main protagonist of the story, the user should make connections that help each stone guardian understand what he is reading. Connections are sentences with ideas about the text itself, the user's personal life, or the world surrounding him. The user can select them from an inventory of connections. If the connections seem logical, the guardian will let down the bridge, and the player can cross it. Conversely, if the guardian could not understand the information in his book, the player will lose one *gem* or *life* for each wrong answer, and he will have to try again. By helping the guardians, the player can cross the bridges one by one and reach the top of the mountain (of understanding). Figure 6 displays the mini-game and shows how this strategy can be used practically for the comprehension of text.

Figure 6
The Connection-Making Strategy
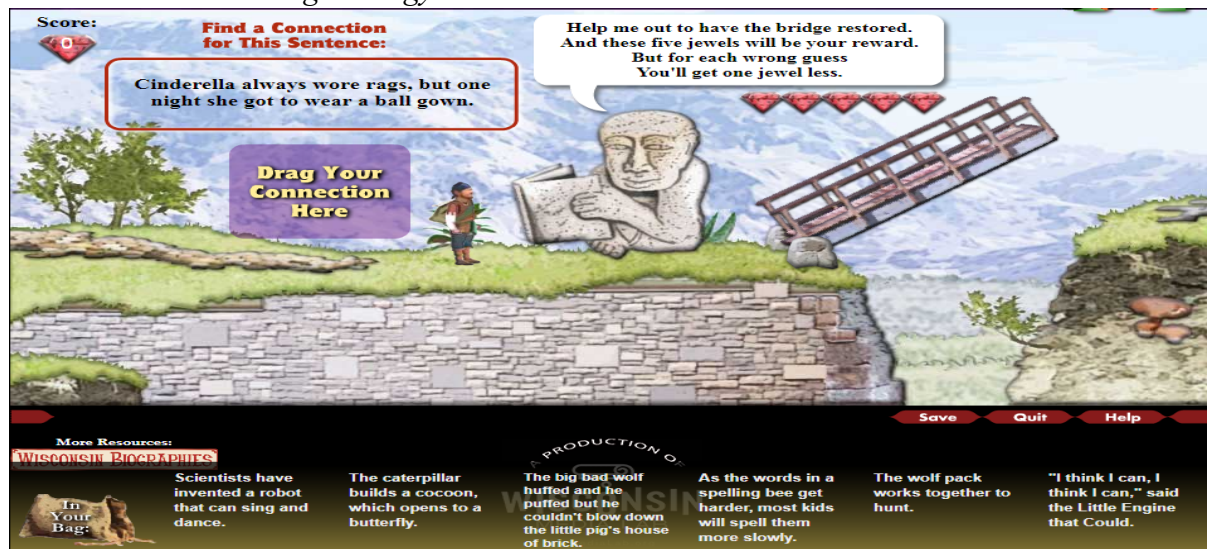
The Synthesizing Strategy

Here the player is shown the picture of a famous person. He can choose from several pictures. Next, he thinks about the person's life and jots down whatever ideas that occur to him on the spur of the moment. Finally, the player will be given parts of a book or will be shown a movie about the person. He needs to put together disparate bits of information to make a coherent whole. This is accomplished by making a bio-picture or a biopic poster for the person in question. Figure 7 shows how this strategy can be employed.

Figure 7
The Synthesizing Strategy

Activating Prior Knowledge

Finally, in the application of this strategy, the player is shown the picture of a head (or asked to imagine a head) with ideas inside the head. He then needs to drag the ideas and drop them into highlighted sentences in the text when they are shown in the game. This is much like putting on your *thinking cap* and pulling out your thought, which helps the player understand the text more fully. There are tricky ideas: If the player chooses them, they will pop back into the head, and he will have to try again. Figure 8 illustrates how this strategy can be applied to text comprehension.

Figure 8
Activating Prior Knowledge

Once the students finished playing the game, they were given the print copies of the select passages from the two reading books introduced earlier. Next, they were asked to apply the strategy they just learned when reading the texts and answer the follow-up multiple-choice

questions. The administration of treatment took between 40 and 50 minutes for the experimental group participants.

As for the control group, the strategies were introduced by the researcher himself, and directions were provided to help with their successful application to the comprehension of texts. The students, however, had no control over content delivery and worked on the example passages presented to them by the researcher. Like their counterparts, they ultimately applied the reading strategies to the comprehension of the select passages from the two reading sources introduced earlier.

The experiment lasted for four weeks and two sessions per week. In the end, the participants sat for a posttest of L2 reading compression. Their exam papers were scored, and the mean scores were calculated and then subjected to tests of statistical significance. Both within- and between-subjects effects were examined.

Results

To gauge the participants' level of L2 reading ability at the beginning of the experiment, a pretest was administered to both study groups. The individual scores were then entered into the data editor of an interactive statistical analysis software package called *Statistical Package for the Social Sciences (SPSS) Statistics*[5]. Version 28 (2021) of the application was used for data analysis. In analyzing the pretest data, a test of statistical significance was employed. Tests of normality, however, were run a priori as a precondition for using parametric tests like the *t*-test. Table 1 summarizes the descriptive statistics for the pretest scores.

Table 1
Descriptive Statistics of the Pretest Scores

| Groups | N | M | SD | SE | 95% CI | | Minimum | Maximum |
					Lower Bound	Upper Bound		
Exp.	15	9.9333	2.18654	.56456	-1.47327	2.00661	6	14
Ctrl.	15	10.200	2.45531	.63396	-1.47223	2.00556	6	16
Total	30	10.066	2.32092	.59926	-1.47275	2.00608	6	16

Note. Exp. = Experimental Group. Ctrl. = Control Group. The mean scores for both groups are below average on the pretest of L2 pragmatic ability.

As can be seen in the table, both study groups delivered a lackluster performance on the pretest, given that the maximum possible score on the test was 30. They performed below average, which is indicative of their limited ability at the beginning of the experiment. In addition, the two groups performed very closely, suggesting that they were homogenous concerning their reading ability.

Table 2 summarizes the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests as indices of normality.

Table 2
Tests of Normality

| | Groups | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
		Statistic	df	Sig.	Statistic	df	Sig.
Scores	Exp.	.120	15	.200*	.952	15	.250
	Ctrl.	.118	15	.200*	.965	15	.261

a. Lilliefors Significance Correction

Note. The results of the tests of normality suggest that the two study groups come from a population with a normal distribution

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[5] https://www.ibm.com/products/spss-statistics

of scores ($p > 0.05$).

As shown by the table, the probability value reported for both tests of normality is higher than the pre-set alpha value ($p > 0.05$), suggesting that the pretest performance scores of the study groups did not greatly deviate from a normal distribution of scores. Shapiro-Wilk is a more robust test of normality compared to Kolmogorov-Smirnov when it comes to small samples (n < 50). The result of this test provides strong evidence for the tenability of such a claim (i.e., the two samples were randomly selected from a population with a normal distribution of scores).

Once the requirements for using parametric tests were satisfied, the mean scores were analyzed using a *t*-test to ascertain whether the observed mean difference was statistically significant and hence meaningful. Table 3 shows the results of the test of homogeneity of variances as well as those of an independent samples *t*-test reported for the pretest means.

Table 3
Results of the Independent Samples T-Test Reported for the Pretest Means

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% CI	
		F	Sig.	t	Df	Sig. (2-tailed)	M Difference	SE Difference	Lower	Upper
Scores	Equal variances assumed	.640	.431	.314	28	.756	.2667	.84890	-1.47223	2.00556
	Equal variances not assumed			.314	27.632	.756	.2667	.84890	-1.47327	2.00661

Note. The assumption of the equality of variances is justified ($p > 0.05$). The size of the between-subjects contrast is not statistically significant as suggested by the parametric test of statistical significance ($p > 0.05$); the groups belong to the same population.

As can be seen in the table, the mean difference is not statistically significant ($p > 0.05$). This suggests that the groups' test scores did not vary greatly at the beginning of the experiment. Table 4 summarizes the groups' performance scores on the post-intervention measure of L2 reading ability.

Table 4
Descriptive Statistics of the Posttest Scores

Groups	N	M	SD	SE	95% CI		Minimum	Maximum
					Lower Bound	Upper Bound		
Exp.	15	21.933	2.49189	.64340	2.75479	6.17854	18	25
Ctrl.	15	17.466	2.06559	.53333	2.75213	6.18120	14	21
Total	30	19.699	2.27874	.58836	2.75346	6.17987	16	23

Note. Exp. = Experimental Group. Ctrl. = Control Group. Both groups made significant progress throughout the study; however, the mean difference is in favor of the experimental group.

As can be seen in the table, both study groups made good progress throughout the experiment; however, the mean difference is in favor of the experimental group, suggesting that DGBRST proved to be more beneficial in improving the learners' L2 reading ability. Further evidence corroborating this view is provided by the results of an independent samples *t*-test reported for the posttest means of the study groups. Table 5 below summarizes the results of this test.

Table 5
Results of the Independent Samples T-Test Reported for the Posttest Means

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% CI	
		F	Sig.	t	Df	Sig. (2-tailed)	M Difference	SE Difference	Lower	Upper
Scores	Equal variances assumed	.303	.586	5.345	28	.000	4.46667	.83571	2.75479	6.17854
	Equal variances not assumed			5.345	27.069	.000	4.46667	.83571	2.75213	6.18120

Note. The homoscedasticity holds for the variances of the study groups ($p > 0.05$); however, the between-subjects contrast is statistically significant ($p < 0.05$), implying that the amount of gain is not comparable in size for the participants of the two groups.

As can be seen in the table, the probability value reported for the *t* statistic is much smaller than the preset alpha value ($p < 0.05$). This suggests that the mean difference is large enough to be statistically significant. The implication is that the two treatment modalities produced differential effects, considered to be statistically significant, on the reading ability of the participants.

Finally, a paired samples *t*-test was employed to allow for the comparison of the pretest and posttest means of the study groups. The results would allow for the measurement of the within-subjects effects as markers of students' progress (if any) throughout the experiment. Table 6 below summarizes the results of the test.

Table 6
Results of the Paired Samples T-Tests

		Paired Differences							Sig. (2-tailed)
		M	SD	SEM	95% CI		t	df	
					Lower	Upper			
Pair 1	Exp. (Amount of Gain)	12.000	3.545	.915	10.036	13.963	13.108	14	.000
Pair 2	Ctrl. (Amount of Gain)	7.266	2.491	.643	5.886	8.646	11.294	14	.000

Note. The probability values reported in the table are below the preset alpha value ($p < 0.05$); the amount of gain achieved by the participants of both groups is statistically significant and large enough to be considered meaningful.

As can be seen in the table, the probability value reported for the *t* statistic is much smaller than our preset alpha level ($p < 0.05$). This suggests that the amount of gain seen in the participants' reading ability is statistically significant and hence meaningful. This is true for both study groups, which shows that both modalities of instruction proved beneficial in improving the reading comprehension ability of the participants, albeit the amount of gain reported for the two study groups is not comparable in size. This is open to further discussion.

Discussion

The results of this study are in line with those of other similar studies that have unanimously shown recognition for the affordances of digital games for education, in general, and language pedagogy, in particular. Even though the present study can be an original piece in the sense that very few experiments have sought to examine the contributions of digital game-based strategy training on students' learning, the results can still be interpreted in light of existing models and theorizing in the field of multimedia learning as well as Technology-

Enhanced Language Learning (TELL) that serve as the theoretical underpinnings of other similar studies.

Babaie (2021), for example, argues that what lies at the heart of multimedia instruction, which is characteristic of gaming environments serving pedagogical purposes, is the multimodal presentation of information to learners. When information in multiple modalities (i.e., text, audio, animation, or a combination thereof) is delivered to learners, there is a great likelihood that multiple memory channels would engage in information processing. Parallel processing of information in multiple memory channels would discount the possibility for one channel (e.g., visual, verbal, or auditory) to be overloaded, which in turn results in efficient processing, better transfer of information, and more effective organization of data in the long-term memory. In the case of reading comprehension, this translates into efficient construction of knowledge and sense-making, which results from the *modality effect* in multimedia learning environments (Moreno & Mayer, 1999; Sweller, 2016).

Another explanation for the greater affordances of DGBRST can be provided in light of Sweller's (2016) Cognitive Load Theory. Sweller (2016) differentiates between three distinct types of cognitive load, namely *intrinsic load*, *extrinsic load*, and *germane load*. Intrinsic load is concerned with the amount of processing that is devoted by the brain to the task at hand. This represents the amount of mental effort that should be exerted by individuals when performing a cognitive task. It could be high or low depending on the task difficulty level. The greater the difficulty level, the greater the mental load. Germane load is the barest minimum amount of cognitive load required for processing a cognitive task. This means the task (e.g., a learning task) could not be performed successfully unless this barest minimum of the mental effort could be devoted to task execution.

We cannot exercise control over intrinsic load, as it correlates with task difficulty: A task can be cognitively demanding. For example, reading comprehension is a cognitive task that requires the integration of many sub-skills, such as phoneme processing, morphemic decoding, mental imagery formation, inferring, connection making (such as linking the information in the text to personal experiences), activating background knowledge, and so on. Germane load, likewise, is not under the teacher's rein, as it represents the minimum amount of mental load that learners spontaneously allocate to processing the learning task. Extrinsic load, on the other hand, is what can be adequately controlled by the teacher or teacher as a designer in the sense that teaching material can be delivered in such a way as to reduce this type of cognitive load. This means extrinsic load correlates highly with the manner of delivery.

In multimedia applications and also gaming environments, this idea is best captured by the designer artfully incorporating features into the game or application that could reduce this type of mental load on the part of the learners. Chief among these features are user-friendliness (i.e., supplying the learners with navigational buttons, sliders, toolbars, maps, etc. that would allow them to move back and forth between different stages or scenes in a game); multimodal presentation of information; giving greater control to learners by allowing them to control the avatars, the time spent on quests, the dialogues shown on the screen, and many other features that could help mitigate the mental burden of the learners (Park et al., 2018).

A further explanation for the likely superiority of game-based instruction is provided by the proponents of the *inquiry-based ubiquitous gaming approach* (Hwang & Cheng, 2017). The approach highlights the invaluable contribution of heuristic, self-paced learning to language learning in gaming environments. Learners' intrinsic motivation is improved, and their critical thinking skills are greatly harnessed as a result. The provision of personalized feedback (Shute & Rahimi, 2017) and opportunities for adaptive learning experiences (Homer et al., 2018) are among the other explanations for why game-based instruction could be privileged over conventional, teacher-centered methods of content delivery.

Conclusion and Suggestions for Future Studies

The present study showed that GBRST holds great promise for improving the reading comprehension ability of EFL learners. Whereas the present study reports on the findings of one of the few experiments that sought to examine the contributions of strategy training to students' learning in a gaming environment, and great care was exercised to eliminate the possibility for *history effect* and other threats challenging the credibility of the findings, it cannot be considered a full-blown study; it suffers from certain pitfalls, and therefore, any judgment, passed based on the results, on the utility of GBRST should be made with the following caveats: The present study employed only 30 learners as the prospective participants largely because of administrative and budget constraints. Future studies may examine the possible contributions of GBRST to the learning of a bigger population of EFL learners to see if the results converge or disagree with the findings of the present study. Of equal interest could be the examination of long-term effects, if any, of GBRST on students' learning, something the researcher did not consider in the present study. Likewise, gender, as a potential covariate, was not controlled in this study. The study groups comprised an unequal number of male and female participants. There is a possibility for gender interacting with the modality of instruction in such a way as to bias the performance scores of one of the two sexes. This can be taken into consideration in further replications of the present study where both main and interaction effects, if any, of gender could be closely examined. Polling EFL learners' perceptions of the overall utility of GBRST could also be an interesting line of inquiry. A mixed methods study yielding quantitative and qualitative data could be a preferred option for researchers wishing to achieve *corroboration* (when both sets of data are in agreement) or *initiation* (when, for example, the qualitative data provide a different perspective compared to the quantitative side of the story). Alternatively, firmer judgments as to the efficiency of GBRST can be made based on the findings of a triangulated study in follow-up experiments. For example, the present study can be replicated by different researchers (showing varying levels of expertise in data analysis) in *investigator triangulation*, or in different places with different constellations of language learners when employing *spatial triangulation*, or through collecting different types of data (e.g., test results, answers to questionnaires, responses to interview probes, etc.) when using *data triangulation*. Finally, limiting the applicability of findings to intermediate EFL learners is a major delimitation of the present study. The researcher deliberately chose to recruit intermediate learners as the participants of the study, as he believed they would be more suitable candidates. Any replication of the present study, then, may recruit groups of mixed-proficiency or mixed-ability learners to see how language proficiency as a potential covariate could mediate the possible effect of the modalities of instruction.

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