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The Effectiveness of Digital Game-based Learning on Alphabet Signs and Word Learning in Persian to Non-Persian-Speaking Children

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Abstract

The present study investigates the effectiveness of digital instructional games (DGBL) on alphabet signs (AS) and Word Learning (WL) in Persian to non-Persian-speaking children. The quasi-experimental method with a pretest-posttest design was applied to the study. Fifty-nine participants were randomly chosen from 400 students in Kalat-e Naderi, Iran. The participants were randomly divided into experimental and control groups. Descriptive and inferential (e.g., covariance) statistics were used to analyze the data. The findings revealed that DGBL significantly enhances AS and WL in Persian to non-Persian-speaking children. It is concluded that instructing AS and WL using the DGBL can improve the learners' performance in Persian learning. This conclusion may have pedagogical implications for language education programs, language instructors, and curriculum designers in academic settings.

Keywords: Digital instructional game, Alphabet signs learning, Letter composition learning, Non-Persian-speaking children

Introduction

Persian learning as a second and formal language in Iranian elementary schools is one of the children's primary skills that enables them to communicate better with teachers and others (Arabi & Soltani, 2018). Persian learning is the first step for the students to receive instruction, learn reading and writing skills, and achieve subsequent development at school (Asareh et al., 2013). Understanding the formal language by children, especially in elementary school, is crucially vital; if it is not done correctly, not only may it make children incapable of communicating with the world around them (Klimova, 2014; Lantolf et al., 2020; Clayton, 2020), but also it might cause the students not to follow the training procedure well (Ghaderi et al., 2018). Thus, learning Persian language skills is fundamental for children, especially in elementary school, since Persian language mastery will bring them academic achievement and self-conceptual success (Yenkimaleki et al., 2023).

Children who grow up within a local language setting experience new challenges when using the national and official language (e.g., Persian). These children are named bilingual students (Arabi & Soltani, 2018). Bilingualism can be applied to individuals or communities using two related languages (Yenkimaleki & Van Heuven, 2022). Bilingualism is one of the most critical issues in the education system of multilingual countries (Kałamała et al., 2022). In Iran, this issue exists due to the diversity of different ethnicities. In some areas of Iran, when bilingual children go to school, they do not understand the material presented by the teacher, which disconnects the teacher and the students from what is taught (Syahrial, 2013; Yousefi et al., 2017) because Persian (e.g., the formal language of the school) is foreign to the local language speakers (e.g., Khorasanei Turkish). Therefore, this problem is common for Iranian bilingual children who enter school with less familiarity with the Persian language. Without mastering the oral aspects of Persian, these students are forced to master Persian reading comprehension and writing skills (Masrabadi et al., 2014). Since the students do not have the required proficiency in Persian, they have ineffective interaction with the teacher during the teaching-learning process, which results in less learning.

The bilinguals' learning of the Persian language is influenced by their learning styles, teaching methods, supporting strategies (Kalantari et al., 2019; Asareh et al., 2013), and the interactional context (Jevtović et al., 2020). This point becomes more thought-provoking and valuable when teaching-learning methods cannot be aligned with the characteristics of children, especially from a cognitive and cognitive-emotional perspective in Iranian schools (JafariShadpai & Zanganeh, 2020; SafaeiMovahed & Rikhtehgarzadeh, 2018). Some studies show that students in bilingual areas of Iran are weaker in reading (Rahmanizadeh, 1998; Izadi, 2012) and writing skills (Masrabadi et al., 2014) or have lexical errors (Sattari, 2000). Therefore, teaching methods, instructional media, and materials could determine the quantity and quality of learning by children, and they must be consistent with children’s learning styles (JafariShadpai & Zanganeh, 2020).

One of the challenges of teachers and trainers is teaching children the alphabet signs. Some scholars address the alphabet signs learning methods, others emphasize word learning methods (e.g., Wyse & Bradbury, 2022; Woore, 2022), and a group believes in blending these methods (e.g., Bashirnezhad, 2020). Since Persian writing is based on the lexical system, the phonetic values of each letter of the alphabet signs for children with conventional methods is a tedious, boring, and sometimes even tricky process, especially when they are bilingual students and are less familiar with the Persian language (Bashirnezhad, 2020). It is essential to have an

instructional strategy that facilitates children's learning of the alphabet signs and words. One of the effective strategies would be the application of DGBL.

DGBL is not only valuable as the blended approach to learning AS and WL in Persian, but it is also compatible with the interests and learning styles of children in the digital age. The new generations live in the modern world with an advanced ecosystem of many exciting technologies such as digital games, virtual realities, simulations, and stimulating multimedia. Instruction without applying new technologies and just through boring classrooms is no longer interesting (Hong et al., 2020; Chapman & Rich, 2018; Buckley & Doyle, 2016; Bouchrika et al., 2019; Yenkimaleki et al., 2021). Applying teaching methodologies with integrating technology will be accompanied by challenges since, through this procedure, more attention will be paid to individual differences (Yu & Tsuei, 2022). Digital learning technologies can accelerate and facilitate learning repetitive, memorized, and tedious things such as AS and WL and make it enjoyable for children (Hu, 2019) by combining them with fun and games. The DGBL can be a teacher's assistant in teaching AS and WL, especially in the sense that they can provide explicit and rapid feedback (Zou et al., 2019) and lead to increasing motivation (Yu & Tsuei, 2022), immersive learning (Becker, 2007), and high-level of interaction (Chen & Line, 2016) among the students. Through this procedure, students learn by playing, experiencing, and excitement (Hu, 2019). Furthermore, new learning technologies, such as digital games, influence the practical and enjoyable learning process (Hwang & Wu, 2011) for AS and WL.

The history of DGBL goes back to video games in the 2000s, which took on new forms with the emergence of personal computers, laptops, tablets, and mobile phones and became more popular and widespread (Bado, 2019; Martin & Shen, 2014). In the instructional technology literature for language learning, various terms have been used for educational games, such as serious games, gamification, digital learning games, action video games, and multiplayer online role-playing games (Li & Lan, 2022). The present study utilizes DGBL because of its conceptual comprehensiveness in education. DGBL was manifested in instructional technology literature by understanding issues and overcoming them through an interactive approach (Mayer, 2022; Abutalebi & Clahsen, 2022; Li & Lan, 2022; Chien et al., 2022; Hu, 2019; JafariShadpai & Zanganeh, 2020).

DGBL, as an instructional strategy for AS and WL of Persian, is one of the educational technologies that have appropriate capabilities to help students to learn vocabulary (Wu et al., 2020; Müller et al., 2018; Zou et al., 2019), spelling (Müller et al., 2018), pronunciation (Zahoor & Kausar, 2018), grammar (Ishaq et al., 2022), reading comprehension skills (Ishaq et al., 2022; Taj et al., 2017), and conversation (Lantolf, 2022). This has appeared with different types of learning approaches, including behaviorism (Li & Lan, 2022), cognitivism (Li & Lan, 2022), and constructivism (Lantolf, 2022). Learning is influenced by various factors, such as personality, learning styles, individual abilities, and motivation (Önal, 2019). Thus, DGBL is an instructional strategy that allows personalizing (Alamri et al., 2020) the learning at the mastery level (Chang & Chen, 2022). DGBL has apparent strengths, which are significantly practical in language learning, especially in learning Persian (JafariShadpai & Zanganeh, 2020).

In terms of the pedagogical aspects of DGBL, it is a paradigm shift from the environment to the learner-centered approach (Reigeluth, 2009). If it is well integrated with the teaching-learning process (Bado, 2019), it can create a rich learning context and environment (Ishaq et al., 2022; Dickey, 2015) for learning AS and WL in Persian. The appropriate instructional design of DGBL increases the cognitive-metacognitive engagement of the learners

(Bado, 2019; Xu et al., 2019; Yuratich, 2020), enhances interaction (Mayer, 2022), helps the students to achieve learning outcomes (Acquah & Katz, 2020), provides quick and timely feedback (Acquah & Katz, 2020; Xu et al., 2020; Furdu et al., 2017), offers exploratory learning activities (Xu et al., 2020), and teaches problem-solving skills (Li & Lan, 2022; Abutalebi & Clahsen, 2022). Moreover, according to the cybergogy approach (Wang & Kang, 2006), DGBL can be a catalyst for instructing AS and WL in Persian, making the teaching-learning process more interesting (Strohschen & Elazier, 2020). Therefore, DGBL for instructing AS and WL in Persian is a learning-oriented strategy (Hsieh et al., 2016; Hwang et al., 2015; Chen et al., 2020) which uses digital capabilities to provide learning opportunities, delivers the instructional message, assesses the achievement of learning objectives, provides immediate feedback to the student and teacher, and supports and evaluates the learning process (Connolly et al., 2007; Vlachopoulos & Makri, 2017; Wu et al., 2020).

The previous findings show that the misconceptions of bilingual students compared to monolingual students still exist despite formal instructions in the representation of vocabulary and the sound structure of words (Galan & Kaldrick, 2012), phonetic arrangements, linking sounds, and forming acceptable syllables (Kew & Anderson, 2012). Teachers currently teach Persian to bilingual students AS and WL by applying conventional methods (JafariShadpai & Zanganeh, 2020), while language instruction should be done with ecological approaches. They do not employ the DGBL or other interactive digital content in their teaching methods (Yu & Tsuei, 2022). The prior studies revealed that one of the reasons for the weakness in the teaching method of the Persian language to bilingual children is the need for integration of technology in instruction (Arabi & Soltani, 2018). Also, recent studies focused on bilingual students' academic issues (Han, 2022; Engemann, 2022; Mooijman et al., 2022) and paid less attention to the strategies and instructional practices that affect the student's learning, especially in the aspect of technology integration issue (e.g., DGBL) (Chien et al., 2022; Abutalebi & Clahsen, 2022; Li & Lan, 2022; Dichev & Dicheva, 2017). Various studies have addressed the advantages of games, including the excellent motivational instrument (Ke et al., 2015; Novak et al., 2018; Van Eck & Dempsey, 2002), the affordance for cognitive dimensions in learning, the practical experience for learning (Ak & Kutlu, 2015; Cornillie et al., 2012; Homer et al., 2018; Chen et al., 2020), the cognitive load management (Wu et al., 2020), the excellent strategy for the immediate feedback (Charles et al., 2011; Hakuline et al., 2015), and the engagement of emotions in learning (Um et al., 2007). However, there is no systematic study to examine the effect of DGBL on AS and WL in Persian.

Therefore, considering the merits of DGBL in language learning, it behooves us to examine it systematically in instructing AS and WL in Persian language learning. The present study is set up to shed more light on this issue by investigating the effectiveness of DGBL in AS and WL learning in Persian to non-Persian-speaking students. The following research questions were raised:

1. Does the DGBL improve the learning of AS in Persian compared to conventional instruction?
2. Does the DGBL improve the skill of WL compared to conventional instruction?

Method

The quasi-experimental method was applied with a pre-test-post-test design with control and experimental groups since the study aimed to investigate the effect of DGBL on AS and WL learning.

Participants

The statistical population of this study was all first-grade school students in Kalat-e Naderi (between 6- and 7-years old children) in the academic year 2020 (N=400). The Persian language is used to teach students in the schools of this region. From this community, it was first determined by the teachers, a school where students have access to computers, tablets, or smartphones. Later, from this community, two classes were selected by convenience sampling method. They were randomly divided into two groups (e.g., control and experimental groups). The number of students in the control group was 30, and in the experimental group was 29.

It should be noted that those learners who were absent during the intervention process for any reason were removed from the list of participants. Inclusion criteria were a) attending the first-grade class, b) being bilingual, and c) studying in the academic year 2020. Exclusion criteria also included individuals who were absent in at least two intervention sessions or who had dyslexia.

Instructional material and content

The game's instructional content included the words and letters of the Persian AS that students had to learn. They should be able to combine letters to make or read the words. The essential words were brother, father, mother, sister, water, bread, etc. These are taught at the beginning and become the basis for the students to learn the following words according to their formal curriculum.

At first, an animation clip was used to teach the alphabet signs, which was part of the game for teaching. It was designed to teach AS and letters to the students through an animation-based story. The game included short and different stories, both in the animation section to teach AS and WL how to combine them and in the exercises section, which was interesting for the students and helped them learn more efficiently. Moreover, it even caused them to have cognitive-emotional engagement. For example, in Fig. 3, the student is supposed to help the baby snake that has moved away from her mother and is across the river to reach her. To do this, the student must click or touch the first stone, and a sound will be played to them, which is consonant with a vowel in Persian. The student must first choose the target AS between different options on the left and then select the considering vowel (in Persian) on the right. If he/she makes the right choice, the baby snake will take one step closer to the mother, but at each stage, if he/she makes a mistake, the baby snake will return to the starting point. Therefore, the student will have to try again. This feedback helped the student be aware of his/her performance, either true or false. After teaching the letter and AS, the animal symbol was transformed into the letter by a morph (a technique in animation). It helps the students imagine each of the letters well in their minds. For example, in instruction, the sign of "O" was shown to the students to teach the word "cow," and the sign of "J" (the first letter of Jojeh –chicken in English) was shown to teach chicken (Jojeh in Persian). Then, the exercises were designed to instruct all other AS and WL. The activities shaped the multi-stages of the game (three stages), and the student had to answer them correctly to pass each stage and go to the next stage. The combination of letters or word formation was taught in at least seven game stages to learn new words and AS, each with different activities. Of course, there were some activities for better learning with the necessary cognitive scaffolding to help the learner memorize words. The instructional designers gradually eliminated the cognitive scaffoldings in the following four stages of the game to help the learners achieve independence in the learning process and memorize words appropriately.

It should be noted that the instructional content was the same for both the control and experimental groups. The instructional content was presented to the experimental group through the DGBL, and the control group received it as a printed copy (e.g., paper). Therefore,

the teacher taught the control group with the printed copy materials, and the experimental group was taught with the digital instructional game. If necessary, the teacher assisted the students in doing tasks during play, especially in the challenging exercises in the final stages of the games. The same teacher taught the same instructional materials to both classes (e.g., the control and experimental groups).

Procedure

The research implementation process was carried out in the following steps: A) Conducting the pre-test: In order to determine the students' previous learnings of AS, WL, and the ability to combine AS to read and memorize words, a pre-test was administered to both groups so that the results of it could be compared with the post-test.

B) Intervention: The intervention in this study was DGBL, which was applied to the experimental group. At first, the students were taught how to install and play the game, and then their behaviors were traced. If they needed to be guided, the teacher helped them. The interfaces and games' design were standardized so students could communicate easily. After the pre-test, they were exposed to the DGBL in the classroom for ten sessions. Each session began with an animated story about one alphabet sign and word. After teaching the letter, it was morphed (as cognitive scaffolding) so the learners could associate them with the desired animal. In the next stage, they started with the first set of exercises, which was easy (just as a repetition strategy). If the learners could not do them, they were supported through more cognitive scaffolding, including reminders and clues to pass this stage successfully and go to the next practice set (e.g., exercise number 2). In the continuation of the series of exercises (e.g., numbers 3 and 4) of the first session, which ranged from simple to complicated and challenging tasks, their context was varied and interesting so that the learners could acquire the power of learning delivery to the new position. If the learners pass all of the practices concerning the first session (lesson 1) with the necessary points and at the right time (as a gamified strategy), they could go to the next session (lesson 2). Otherwise, they must perform the set of compensatory exercises in the first session. If they were able to do them at the right time, they could advance and go to the next session; otherwise, they would have to repeat the first session (lesson 1). This process was repeated for all ten sessions. It should be noted that previous lessons were also reviewed during the sessions to help the learners remember. The learners were aware of their performance in all exercises by providing feedback to reinforce their function and learning.

It should be noted that the instructional content was given to the control group in paper form. The instruction and exercises were similar to the experimental group in terms of content but different in terms of representation and interaction. Because it was based on the capabilities of DGBL (experimental group), it was possible to use various media in an attractive way, but it was not feasible in paper form. The goal was only to measure the impact of DGBL on AS and WL in Persian. C) Implementation of the post-test: After the intervention, a post-test was taken from the learners. It should be noted that the pre-test and post-test levels were the same as the standardized tests of Iranian schools in this field. More details are shown in Table 1.

Table 1

Pre-test and post-test of control and experimental groups

Groups	**Pretest**	**Intervention**	**Posttest**
Experimental	T1	X	T2
Control	T1	-	T2

Figure (1). Game Recognizes the AS through sound

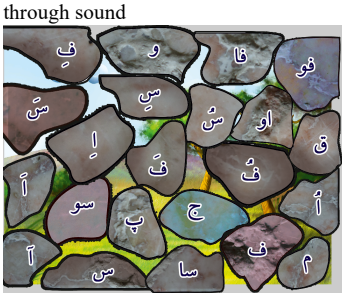


Figure (2). Game AS recognition

Figure (3). Play a combination of silence and sound through sound

Figure (7). Secondary morpheme converts the chicken image to letter J in Persian

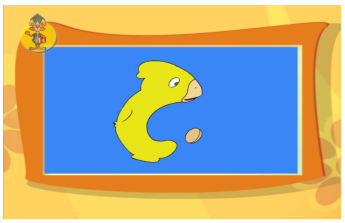


Figure (4). The initial morph converts the image of a cow to the letter O in Persian

Figure (5). The secondary morpheme converts the image of a cow to the letter O in Persian

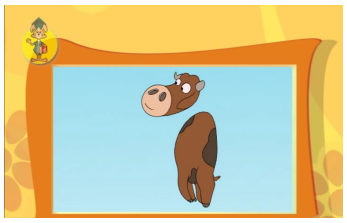
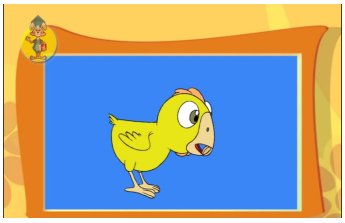


Figure (6). The initial morph converts the image of the chicken to the letter J in Persian



Data Analysis

Descriptive and inferential statistics (ANCOVA) were used to analyze the data. Since the quasi-experimental method was used with a pre-test and a post-test with a control group, *covariance analysis* was needed to control disturbance variables to eliminate its effect. Therefore, an analysis of covariance was used to analyze the data.

Ethics

Ethical approval to involve these participants in the study was obtained. All the participants agreed to take part in the research project by indicating their informed consent. Also, they are assured that their information will remain confidential.

Results

The findings are presented in two sections. The first section includes descriptive statistics on research variables, including mean and standard deviation (Table 1). The second section contains the testing of the research hypotheses presented using the ANCOVA analysis and their preconditions.

Table 2

Descriptive Indicators of the Two Groups in Pre-test and Post-test

Variables	Test	Group	N	Mean	SD	Std. Error Mean
AS	Pre-test	Control	30	3.46	1.51	.271
		Experiment	29	3.86	1.48	.275
	Post-test	Control	30	12.76	2.37	.433
		Experiment	29	16.13	2.88	.536
WL	Pre-test	Control	30	3.5	1.50	.274
		Experiment	29	3.58	1.93	.359
	Post-test	Control	30	12.66	2.63	.480
		Experiment	29	15.75	2.04	.380

As Table 2 shows, the means obtained in the post-tests of both experimental groups (AS & WL) are higher than those of the pre-test. Moreover, both experimental groups in the post-test scored higher than the control group. This means that the DGBL leads to the learners' performance improvement in AS & WL.

Does the DGBL improve the learning of AS in Persian compared to conventional instruction? For this purpose, the ANCOVA analysis was employed. It is commonly applied in pre-test and post-test designs. Before using the ANCOVA analysis, some preconditions must be met. Although this test has several preconditions, three of them (e.g., data normality, variance homogeneity, and regression slope homogeneity) have been referred for both groups.

For the first precondition to use the ANCOVA analysis, The Kolmogorov-Smirnov single-sample test was applied to assess the normality of the factors (Table 3).

Table 3

Kolmogorov-Smirnov test to determine the Normality of Researcher Variables

One-Sample Kolmogorov-Smirnov Test					
Number		AS		WL	
		Pre	Post	Pre	Post
		59	59	59	59
Normal Parameters	Mean	3.81	14.42	3.54	14.18
	Std. Deviation	1.48	3.12	1.71	2.81
Kolmogorov-Smirnov Z		1.148	.766	14.1	.865
Significance level (two domains)		.143	.601	.143	.433

According to Table 3, it is shown that the values of the significance level of the research variables in both groups (AS and WL) are more than 0.05 ($p \leq 0.05$). Therefore, we can state that the data are normal and parametric tests (the ANCOVA analysis) can be applied to analyze the research hypotheses.

For the second precondition to applying the ANCOVA analysis, Levene's test has been applied to check the homogeneity of variances (Table 4).

Table 4
Levene's test to examine the homogeneity of the variances.

Group		Levene's Test	Df		Sig
			First	Second	
AS	Pretest	.179	1	57	.673
	Posttest	2.54	1	57	.116
WL	Pretest	2.65	1	57	.109
	Posttest	2.33	1	57	.132

As Table 4 shows, it is revealed that the variance of the two groups (AS and WL) is higher than the desired level of significance (0.05). Therefore, the ANCOVA analysis could be used to examine the differences between groups.
For the third precondition to use the ANCOVA analysis, the F test has been used to examine the homogeneity of the regression slope.

Table 5
Regression slope homogeneity test

Group	Indicator	Type III Sum of Squares	Df	Mean Square	F	Sig.
AS	Group	5.66	1	5.66	.804	.374
	Pretest	3.22	1	3.22	.458	.501
	Group confrontation/pre-test	5.98	1	5.98	.850	.361
	Error	387.3	55	7.04		
WL	Group	37.81	1	37.81	6.650	.013
	Pre-test	4.99	1	4.99	.880	.352
	Group confrontation / Post-test	1.57	1	1.57	.277	.600
	Error	312.4	55	5.68		

As Table 5 illustrates, the F values (F = 0.850) and (F = 0.277) of the two groups (AS and WL) are not significant ($p \geq 0.05$). It indicates the homogeneity of the regression slope of the two groups. Therefore, it can be stated that the regression slope is homogeneous in the groups, and the correlation test could be applied to analyze the data. Since the preconditions are met, the ANCOVA analysis can be applied to investigate the DGBL impact on learning AS in Persian compared with conventional instruction.

Table 6

Variance-covariance matrix

F	df1	df2	Sig
3/468	1	57	0.068

Table 6 shows the multivariate test of the variance-covariance matrix. The F is significant (p≥0.05). Therefore, it shows that the variance-covariance matrix is homogeneous. In the following, the ANCOVA analysis of the groups (*the effect of the DGBL in the posttest on improving the learning of the alphabet signs*) has been applied to analyze the significance of the difference between the means.

Table 7

Analysis of covariance to compare the mean of the two groups of control in the post-test

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Pre-Test	3.51	1	3.51	.499	.483	.009
Group	168.99	1	168.99	24.06	.001	.301
Error	393.31	56	7.02			

Table 7 shows a significant difference between the mean of the post-test scores for the two groups in learning AS by controlling the effect of the pre-test (F = 24.06). Therefore, DGBL improves learning of AS when compared to conventional instruction. Based on the effect index (Eta coefficient), 30% of the increase in learning AS is due to the DGBL effect in the experimental group. *Does the DGBL improve the skill of WL compared to conventional instruction?*

Table 8

Variance- covariance matrix

F	Df1	Df2	Sig
2.22	1	57	.141

According to the ANCOVA analysis from Table 8, the value of F is significant (p≥0.05). Therefore, the variance-covariance matrix is homogeneous. The ANCOVA analysis of the groups (*the DGBL effect on improving WL in the post-test*) has been applied to analyze the significance of the difference between the means.

Table 9

Analysis of variance to compare the means of the two control and experimental groups in the post-test

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Pre-Test	3.99	1	3.99	.713	.402	.013
Group	139.68	1	139.68	24.91	.001	.308
Error	313.91	56	5.61			

Table 9 illustrates a significant difference between the mean of post-test scores for the two groups in skills of WL and controlling the effect of the pre-test (F = 24.91). Therefore, DGBL improves the learning of letter composition compared to conventional instruction. The obtained effect index (Eta coefficient) indicates that 31% of the increase in learning WL is due to the DGBL effect in the experimental group.

Discussion

The present study investigated the DGBL effect on students' learning of AS and WL. The findings revealed that the DGBL compared to conventional instruction, significantly enhanced the students' learning in AS and WL.

The DGBL's impact on AS learning

In terms of the effect of DGBL on AS, the findings are consistent with the results of previous studies such as Qadri et al. (2022), Hulme & Snowling (2014), Clayton's (2022), Kokkalia & Drigas (2016), and Kuswandi & Fadhli (2022). In the study of Qadri et al. (2022), mobile games had positive effects on teaching Persian alphabet signs through conditioning and association. We argue that the effectiveness of DGBL is the conditional connection created during different stages of DGBL in students' minds so that learning of letters and their correct pronunciation becomes automatic for the students.

In Hulme & Snowling (2014), the authors stated that the ability to recognize letters, sounds, and their correct pronunciation, positively affected children's word learning. The findings of this study can also be due to the instructional design of DGBL that AS recognition, which was first taught through animation, then by the morphing technique in the animation. Our assumption is that the corresponding animal was transformed into AS (such as a Jojeh in Persian to J) to be associated well in the learners' minds and help them to remember easily (i.e., a kind of cognitive scaffolding).

According to Clayton's (2022) study, creating an automatic connection between letter sounds and letter knowledge plays a significant role in word learning. Another issue in this study is the use of various exercises with different difficulty levels and multiple contexts, which are used to condition and automate the students' learning of letter-sound in DGBL. It could be pointed out that with enough practice, the letter-sound connection can be completed, and the learners, based on the knowledge of the letters they have acquired, could use the combination of letters well and pronounce the words correctly in real situations. Kokkalia & Drigas (2016) have shown that DGBL is effective in learning in preschool education for children with special needs (e.g., autism). The current study was conducted on children without cognitive or learning disabilities, and the results showed the effectiveness of DGBL in the learning of AS.

Kuswandi & Fadhli (2022) showed that students with a context-independent cognitive style perform better through gamification (e.g., a type of DGBL) in preschool education. Another reason for the effectiveness of DGBL in this study may be its instructional design since the students perceived the points in their styles and went at their own pace. Some students progress quickly, and some need more exercises to improve; however, DGBL is appropriate for all of them.

The DGBL's impact on WL

The present research findings are consistent with previous studies, such as Zou et al. (2019), Chen et al. (2019), Tsai & Tsai (2018), Fisser et al. (2013), and Yang et al. (2020). During their systematic review, Zhou et al. (2019) concluded that DGBL has a positive effect on learning English words, facilitating reading and comprehension skills, and increasing

motivation and involvement, which is in line with the findings of our study. The effectiveness of DGBL in the present study can be because of engaging the students during the learning process. Since when the learners are active during the learning process compared to when they are not active, their learning rate increases a lot (Zanganeh & Pourjamshidi, 2022). In DGBL, learners were cognitively and behaviorally active, and they could only complete the game stages when they successfully completed the exercise with the minimum required points through playing (learning through doing exercises and quizzes). Another factor that caused the effectiveness of DGBL in terms of combining letters and reading words can be due to a lot of exercises and repetitions in DGBL in various contexts during different stages of the game. It helps them to retrieve words from their long-term memory.

The results of Chen et al. (2019) also showed that the performance of learners in terms of learning and recalling words in the experimental group through DGBL has a significant difference compared to the learners' performance in the control group. The findings of the present study converged with that of them. This effectiveness can be due to other factors included in the instructional design in elements of DGBL, such as providing timely feedback, cognitive scaffolding when needed, and gamification of words during various stages and exercises that the learners are constantly exposed to. The findings confirm the claim of Zanganeh and Pourjamshidi (2022) that assessment as learning increases learning.

Conclusions, Applications, Limitations, and Future Works

The penetration of information technology into the world of education, particularly language education, has strongly influenced the teaching-learning process of learners from a cognitive, emotional, and social perspective and has created new learning environments. The primary purpose of this study was to study the effectiveness of DGBL on the learning of AS and WL in Persian to non-Persian-speaking children.

The use of DGBL for instructing alphabet signs, letters, and learning words has been effective in the Persian language to non-Persian speakers in elementary school students. DGBL's effectiveness would be increased when instructing alphabet signs, letters, and words of the Persian language to non-Persian speakers. It takes place through sound-letter conditioning using:

- Cognitive scaffolding (such as animated morphs);
- Applying many exercises during the design game;
- Diversifying the exercises in order to increase the attractiveness for the learner;
- Using learning contexts during various exercises to make the activities attractive and meaningful for the learner;
- Leveling the exercises from simple to challenging to increase the child's success during the game;
- Taking an assessment approach to the exercises in order to identify the learner's problems and providing appropriate and timely feedback to improve the learner's performance;
- Gamifying all the exercises and instructions;
- Personalizing the exercises and all of the instructions through the game;
- Providing the opportunity for learning mastery by considering individual differences;

Therefore, the appropriate instructional design of DGBL in instructing Persian alphabet signs, letters, and words to non-Persian-speaking children in the first grade of elementary school enhances active learning through cognitive and behavioral interaction during the game.

The pedagogical implications of this study would pertain to language education programs (at least in Iran). Educational policymakers, curriculum developers, practitioners, and

administrators should change their overall approach to language teaching in bilingual environments.

This study has some limitations. This study's participants were fifty-nine students divided into two groups (e.g., experimental and control groups). We could not conduct the experiment with a large number of students since we were unable to find other schools with the required technology to do the experiment. We applied a cross-sectional study design for this study. Future research is recommended with mixed-methods design in longitudinal or cross-sectional studies to explore the learning process of alphabet signs and word learning through DGBL.

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Statements on open data, ethics, conflict of interest

The corresponding author can send the data by request. The participants were protected by hiding their personal information during the research process. Moreover, permission was obtained from the university's ethics committee, and the committee's recommendations were followed.

There is no potential conflict of interest in this study.

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