LAA: Learn the Arabic Alphabet: Integrating Gamification Elements with Touchscreen Based Application to Enhance the Understanding of the Arabic Letters Forms

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Abstract: Touchscreen devices provide a variety of features and engaging interaction which offer a significant incentive for them to be adopted for learning purposes. They facilitate access to educational resources at any time and broaden the study contents beyond the formal curricula of educational institutions. This is promoted by employing educational applications that stimulate learners to interact effectively with the learning material to gain motivation, influencing their accomplishments in the targeted subject. However, some applications fail to provide a variety of feedback to their stakeholders by relying on evaluating learners either negatively or positively in a simplistic manner and with a lack of reinforcement. This unsuitability and the lack of feedback can lead to a weak level of interaction and decrease students' comprehension levels. In this paper, a multi-platform touchscreen-based application has been developed by adopting gamification to support learners with limited literacy skills in acquiring the Arabic alphabet. A study was conducted on 75 native Arabic learners studying in the first and second year of elementary level in Saudi Arabia to evaluate the system's ability to increase learners' knowledge of the Arabic alphabet. The sample was divided into three groups; experiment, and control groups (both first-year) and second-year groups. The experimental group utilized the application after taking the pre-test, while the control group interacted with the learning material traditionally with their teachers. The second-year group results assisted the study in investigating the system's ability to rapidly boost the experiment group's comprehension of the targeted subject since the second-year learners were more experienced in Arabic letters than the experiment or control groups. The results of the comparison of the pre-test and post-test showed that the experiment group overtook the control and the second-year group regarding the post-test score, which indicates the system's ability to increase learners' knowledge level. By providing an interactive and engaging learning experience, the developed application has shown the ability to increase learners' knowledge levels significantly. These research findings have implications for educators, learners with limited literacy skills, curriculum developers, and researchers who are seeking effective tools to improve language learning outcomes.

Keywords: Touchscreen technology, Feedback, Reinforcement, Language learning, Gamification

1. Introduction

Mastering language letters strongly predict learners' s' literacy levels, such as reading ability and comprehension (Piasta, Petscher and Justice, 2012; Roberts, Vadasy, and Sanders, 2019). The acquisition of letters is considered simple, but the reality is that young learners find learning the alphabet challenging and complex (Seidenberg, 2013). Moreover, learning the Arabic alphabet is specifically considered a challenging task for learners due to the complex visual orthographic features, making it hard to master among 1st and 2nd-grade students (Yassin, Share and Shalhoub-Awwad, 2020). Traditional learning approaches are widely utilized in language learning classrooms, and they are derived from teacher-centered learning that relies on improving learners' memorizing skills by repetition (Gibson, 2008). These approaches are inflexible regarding location and time, and usually deliver knowledge to students in a standardized form without considering the individual differences between students like language proficiency, technological skills, cultural background and learning context (Mohammadi, Ghorbani and Hamidi, 2011a). Also, they rely on teacher-centered learning which gives teachers the job of delivering knowledge and restricts the students to a passive role (Mohammadi, Ghorbani and Hamidi, 2011b). Additionally, traditional language learning approaches have other limitations and shortcomings, such as the failure to provide feedback to individual students, particularly when dealing with a large class, which leads to a lack of students' attention and create a gap between classroom learning and real-life language usage (Schwerdt and Wuppermann, 2011). Utilizing technology to enhance language learning in traditional classroom environments can have several benefits such as; allowing students to obtain immediate feedback, boosting their learning achievement, and increasing students' literacy skills (Wang, An and Wright, 2018). Also, integrating technology in the field of language learning can decrease students' anxiety level and increase their motivation, engagement and confidence (Riasati, Allahyar and Tan, 2012; Lai, 2019). Touchscreen devices such as tablets are

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being utilized in language classrooms due to their accessibility to various language learning applications (Yang, 2020). Touchscreen devices offer new opportunities for students to improve their skills development and support young learners' literacy development (Dickinson, Nesbitt and Hofer, 2019; Piasta *et al.*, 2021). A user-friendly interface and a simple finger-based interaction offered by touchscreen devices can support young students' essential skills development, such as cognitive and literacy skills (Couse and Chen, 2010; Liu and Hwang, 2020). Touchscreen devices have the ability to incorporate various learning techniques, such as gamification. The benefit of the idea of integrating gamification elements in education has been discussed in different studies. Hoffman and Nadelson (2010) and Watson, Mong and Harris (2011) point out that gamification can considerably increase users' level of motivation engagement and the flow of the learning content. Therefore, employing gamification in classrooms can lead to an enhancement of their class progression and achievement (Kuh *et al.*, 2006; Watson, Mong and Harris, 2011).

In recent years, the integration of touchscreen-based applications has shown potential for enhancing language learning outcomes among students. Therefore, this study aims to investigate the impact of a touchscreen-based application on native Arabic-speaking learners' Arabic letter comprehension. Specifically, this research addresses the following research questions:

RQ1. How does the use of a touchscreen-based application impact native Arabic-speaking students' comprehension of Arabic letters?

RQ2. What are the differences in Arabic letter comprehension between learners who interact with the touchscreen-based application and those who receive traditional instruction?

RQ3. What are the implications of incorporating gamification and interactive technologies, such as the touchscreen-based application, for language learning outcomes in elementary education settings?

In this paper, a touchscreen-based application called Learn the Arabic Alphabet (LAA) was designed and developed to teach the Arabic alphabet to young learners. This study demonstrates the potential of multi-platform touchscreen-based applications and gamification techniques in supporting learners with limited literacy skills in acquiring the Arabic alphabet. The findings of the research study have the potential to positively impact teaching and learning practices, curriculum development, and educational policies in the context of Arabic alphabet acquisition and potentially extend to other areas of education as well.

Section 2 provides a literature review. Section 3 examines the characteristics of Arabic letters, followed by Section 4, which discusses gamification elements. Section 5 presents the system framework, and Section 6 presents the interface. Additionally, Section 7 describes the methodology, and Section 8 highlights the results. Section 9 presents the discussion, followed by Section 10, which concludes the study.

2. Literature Review

2.1 Touchscreen Based Applications

Touchscreen applications are software programs that are designed to run on touchscreen devices such as smartphones and tablets. They let users engage with the screen directly using touch gestures. These programs serve a variety of purposes, including education, gaming, productivity, and entertainment. They provide intuitive and user-friendly interfaces that are optimized for touch inputs, making them mobile-friendly and accessible (Neumann and Neumann, 2014). These applications have changed the way we engage with technology, making it more engaging and immersive. Various attempts have been made to develop touchscreen-based applications to improve and support learners' language acquisition needs. For instance, Hashim, *et al.* (2017) developed a mobile-based application named ARabic by integrating augmented reality technology with the methodology based on Analysis, Design, Development, Implementation, and Evaluation (ADDIE) to support young learners with limited literacy skills to learn the Arabic language. Lee, *et al.* (2017) designed an application based on augmented reality to teach pre-school learners different aspects of English language such as speaking, reading and vocabularies. Rahmat, *et al.* (2018) integrated augmented reality with mobile devices to develop an interactive learning application to learn Arabic letters. Chiu (2017) utilized a Virtual Reality (VR) approach with mobile VR glasses to build an immersive environment to teach Taiwanese language. Wen (2018) developed a touchscreen-based application by utilizing augmented reality to teach the Chinese characters. Aljojo, *et al.* (2019) designed a touchscreen-based application to enhance kindergarten learners' literacy skills. Their system was able to develop users' pronunciation skills with high satisfaction. Also, Aljojo, *et al.* (2018) developed a system based on a mobile touch screen targeting language skills of children with dyslexia and the system aimed to enhance their attention ability.

2.2 Game Based Learning

A game-based learning strategy is one that combines aspects of games into the learning process. It entails engaging learners and improving their educational experience by utilizing game mechanisms such as challenges, rewards, and interactive components (Kapp, 2014). Game-based learning tries to make learning more interesting, engaging, and successful by applying game design ideas to educational content. Through the engagement and motivation given by games, it stimulates active involvement, problem solving, critical thinking, and skill development (Al-Azawi, Al-Faliti and Al-Blushi, 2016). Gamification, on the other hand, is the act of incorporating game features, mechanics, and design concepts into non-game environments such as education by using game components like points, badges, leaderboards, levels, and incentives to inspire and engage learners in non-game tasks (Al Fatta, Maksom and Zakaria, 2018; Hamari, Koivisto and Sarsa, 2014). Different researchers employed game-based learning in their applications to enhance user motivation and engagement. Yang, Lin and Chen (2018) developed a tablet-based game for English language learning to reduce anxiety among learners. The study found an inverse correlation between the participants playing performance and their stress levels. In other words, as the participants' performance improved, their stress levels decreased. Wihidayat, Utami and Budianto (2018) added a gamification element to a transformed version of an Arabic language textbook that could be played on mobiles to increase learners' engagement and motivation.

Several studies concentrated on providing different formats of feedback. For instance, Liu, Wang and Lee (2021) developed a digital game for language learning that aims to provide information feedback to the user. The study found a strong relation between feedback and motivation. Castañeda and Cho (2016) developed a mobile game to assist learners in learning Spanish verbs. The experiment showed learners were motivated by the immediate feedback given by the application. Al-Razgan and Alotaibi (2022) developed a mobile game application aimed at teaching young students the Arabic orthography. The study indicated that students receiving instant feedback were encouraged to perform better during the experiment.

However, some researchers argue that some touchscreen applications failed to provide appropriate feedback (Niels and Benjamin, 2012; Soni *et al.*, 2019) and how the feedback was delivered to their users (Benton *et al.*, 2018). This point was evident in El-Sawy, Loey, and El-Bakry's (2016) research that developed a multi-agent touchscreen system to teach young learners the Arabic alphabet by giving immediate feedback. The system provided feedback which was based on displaying sentences and hints, making it difficult for learners with limited literacy skills to read them. Previous research (Al-Razgan and Alotaibi, 2022; El-Sawy, Loey and El-Bakry, 2016) found that feedback and gamification or game-based learning are important tools which can be applied to produce more effective learning. Touchscreen and game-based application, with well-designed effective feedback has been shown to be a promising way forward. However, there are limitations to previous research related to Arabic language learning for children, like those approaches failed to offer a diverse range of feedback and reinforcement, which could result in a weak level of interaction and decreased comprehension levels among learners. This study addresses these limitations by adopting gamification (Multi-Platform Touchscreen-Based Application), which aims to provide an engaging and interactive learning experience, which can potentially address the issue of inadequate feedback variety and increase learner motivation. Furthermore, the study incorporates a comparative design by dividing the sample into three groups: an experiment group, a control group (both groups consisted of first-year learners), as well as a second-year group. The inclusion of a second-year group allowed for investigating the system's ability to rapidly boost comprehension levels, given the second-year learners' prior experience with Arabic letters.

3. Characteristics of Arabic Letters

The Arabic alphabet contain 29 letters, including Hamza (ء) serves as a marker for indicating the stress sound as discussed in section 3.4), and are written from right to left. The Arabic letters' complexity features are based on similarity, allography, ligaturing and diacritics. (Yassin, Share and Shalhoub-Awwad, 2020). Similarity refers to shared visual characteristics or patterns among certain letters, allography involves multiple ways of writing the same sound in Arabic, ligaturing refers to the joining or connecting of specific letter combinations, and diacritics (also known as tashkil or harakat) are small marks or symbols that are added above or below the letters to indicate the pronunciation or phonetic value of the letters. These features and the complex orthography of the letters slow the reading process causing difficulties in learning the Arabic language even for Arabic native speakers (Ibrahim, Eviatar and Aharon-Peretz, 2002) and cause difficulties and confusion to young learners aged 6 to 9 when learning to spell (Yassin, Share and Shalhoub-Awwad, 2020). The following sections will describe each feature of the Arabic letters.

3.1 Letters' Similarity

Many Arabic letters are identical in their fundamental letter structure but differ in the number and placement of their dots. For instance, the letter ث/tha:ʔ/ /th/ has three dots above the main shape of the letter and the letter ت /ta:ʔ/ /t/ has only two dots above the letter's shape. Also, some letters change their shape based on their place in the word. For instance, letter هـ /ha:ʔ/ /h/ changes its structure form to a different form to be ـه or ه at the end of the word and to this shape ـهـ in the middle of the word.

3.2 Letters' Ligaturing

The Arabic letters have a joining shape called ligaturing and depend on the letter's position in the word (Table 1). It is considered the most visual feature of the Arabic language (Yakup *et al.*, 2015). Some words can have an isolated form of letters, such as the word وردة /warda/"a rose" and some words can have a fully connected form of letters, such as the word بنت /bent/"girl". Also, some words can contain both isolated forms of letters and connected, such as the word اثاث /athath/"furniture".

Table 1: The Ligaturing in the Arabic Letters

Final non-ligated	Final ligated	Medial ligated	initial	Isolated	Final non-ligated	Final ligated	Medial ligated	initial	Isolated
ض	ـض	ـضـ	ضـ	ض	ا	ـا	ـا	ا	ا
ط	ـط	ـطـ	طـ	ط	ب	ـب	ـبـ	بـ	ب
ظ	ـظ	ـظـ	ظـ	ظ	ت	ـت	ـتـ	تـ	ت
ع	ـع	ـعـ	عـ	ع	ث	ـث	ـثـ	ثـ	ث
غ	ـغ	ـغـ	غـ	غ	ج	ـج	ـجـ	جـ	ج
ف	ـف	ـفـ	فـ	ف	ح	ـح	ـحـ	حـ	ح
ق	ـق	ـقـ	قـ	ق	خ	ـخ	ـخـ	خـ	خ
ك	ـك	ـكـ	كـ	ك	د	ـد	ـد	د	د
ل	ـل	ـلـ	لـ	ل	ذ	ـذ	ـذ	ذ	ذ
م	ـم	ـمـ	مـ	م	ر	ـر	ـر	ر	ر
ن	ـن	ـنـ	نـ	ن	ز	ـز	ـز	ز	ز
ه	ـه	ـهـ	هـ	هـ	س	ـس	ـسـ	سـ	س
و	ـو	ـو	ـو	و	ش	ـش	ـشـ	شـ	ش
ي	ـي	ـيـ	يـ	ي	ص	ـص	ـصـ	صـ	ص

3.3 Letters' Non-Linearity and Diacritic

The Arabic language uses diacritic (Tashkeel) which are symbols located above or under the letter to indicate its phoneme (Daniels and Share, 2018). The diacritics in Arabic language also referred to as harakat include "fatha" (/ʔal-fatħatu/ ◌َ) produce the sound /a/ , "damma"(ʔa-dˤammatu/◌ُ) produces the sound /u/ and "kasra" (/ʔal-kasratu/◌ِ) which produces the sound /i/ (Saiegh-Haddad, 2018). These diacritics can appear in a double form to represent the letter phoneme at the end of the word (Yassin, Share and Shalhoub-Awwad, 2020). These diacritics are "double damma" (◌ٌ) /un/, "double fatħa" (◌ً) /an/, and "double kasra" (◌ٍ) /in.

3.4 Hamza in the Arabic language

The Hamza (ء) in Arabic guides the stress sound of the glottal stop, and it can appear in isolated form or above or under only four letters (Abdelhadi, Ibrahim and Eviatar, 2011). Therefore, hamza does not change its shape but changes the forms of these four letters depending on their position in the word (Table 2).

Table 2: The Hamza in the Arabic Letters

Hamza isolated					Final non-ligated					Final ligated					Medial ligated					Initial				
ء	أ	ؤ	ئ	إ	ء	أ	ؤ	ئ	إ	ء	ـأ	ـؤ	ـئ	ـإ	ء	ـأ	ـؤ	ـئ	ـإ	ء	أ	ؤ	ئ	إ

4. LAA Overview

The system is designed to be used by a single user aged 6 to 9, as it targets individual learners with limited literacy skills to teach them all forms of Arabic letters. The application is touchscreen-based which does not require a complex level of interaction since the main users are learners. Utilizing touchscreen devices seems ideal due to their affordability, ease of use and popularity. Therefore, the application can run on different platforms, such as the iPhone operating system (IOS) and Android, and can be installed easily without the researcher's intervention.

5. Gamification

The proposed system employed different gamification elements such as feedback, difficulty levels, and badges to increase and sustain the users' motivation. Also, it integrated the Arabic alphabet learning contents into the game scopes. Figure 1 illustrates the gamification elements and they are explained as follows:

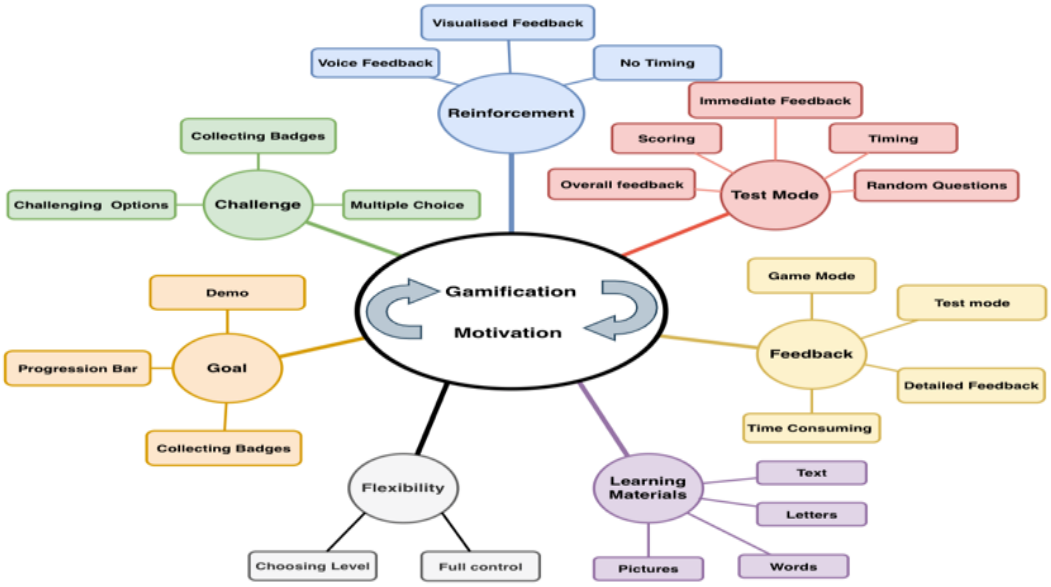

Figure 1: The Application Gamification Elements

5.1 Reinforcement

The system increases learners' motivation by reinforcing and supporting them during the game by utilizing visual and sound reinforcement. The reinforcement response occurs in the playing mode when the user has a wrong attempt. A mixture of visual and sound hints will play and appear to give the user a clue of the correct answer. Also, when the user has a correct answer, a spoken reinforcement plays to increase their satisfaction while playing.

5.2 Test Mode

The application allows learners to examine their achievement and understanding of Arabic letters. The test mode is based on two kinds of feedback: immediate feedback after each answer and overall feedback after finishing the test. Learners will answer ten questions with timing and be able to see their progression score during the test.

5.3 Learning Materials

The learning contents of the application are critical due to the limited literacy level of the main users. Thus, the application learning materials avoid complex words and are chosen based on the Saudi official curriculum and different Arabic lexicons. Furthermore, the learning content is specifically adapted to increase engagement by

adding voices and images and making them more interesting for young learners. The learner profiles are utilized for adaptive learning within the touchscreen-based application. The learner profiles serve as dynamic records of each learner's progress, strengths, and areas for improvement. By leveraging this valuable information, the system can tailor the learning experience to meet the individual needs of each learner.

5.4 Feedback

The application contains four types of feedback:

5.4.1 Immediate feedback

The immediate feedback aims to evaluate learners' answers after their attempts in the play and test mode. In the play mode, learners receive feedback only after their correct attempts, while in the test mode, they receive them after either their wrong or right answers. Also, the added multimedia elements aim to guide learners while interacting with the game and show them the pronunciation of words and letters.

5.4.2 Overall feedback

This occurs after finishing the game and the test task. Stars will appear alongside their score to show the user the status of their progression.

5.4.3 Reinforcement feedback

Learners need to be reinforced while interacting with the application. The reinforcement occurs in the playing mode when learners have wrong or correct attempts. When their answer is correct, a cheering sound will play with fireworks appearing on the screen, and the progression bar will be increased. When they have a wrong attempt, voiced feedback will play with a visualized hint showing learners how their answer is matched with the provided word.

5.4.4 Detailed feedback

Learners can access the results page to see their attempts. The detailed feedback will show users their attempts and the time taken to answer them. Therefore, learners will improve their performance after seeing their weak points and concentrating on which letter, they got wrong the most.

5.5 Challenge

While interacting with the game, learners aim to collect stars to boost the progression bar. This challenge must be achieved to complete the game cycle. Some of the game levels contain multiple choice questions with seven tricky options that challenge learners to choose from. Therefore, these features can enhance the challenging, motivating feeling in learners. Also, the exam mode brings a challenging experience to the user since only immediate feedback appears during the test mode.

5.6 Goal

The game goal is illustrated to the young learners as a demo at the beginning of the game. The step gives learners instructions on interacting with the game and their goal while playing. Learners must answer 28 questions to complete the game cycle; every seven questions mean that learners earn one star. Learners must collect all four stars to finish the game and make the reward.

5.7 Flexibility

The application gives learners complete control of the game by allowing them to start from any point they desire. Learners can switch between questions and skip answering questions when they feel it is too difficult for them, and they can return to the question later in the game. It is worth to mention this feature is only applicable during the playing mode.

6. System Framework

The development of a touchscreen-based application required different programs and platforms. The game was designed by utilizing the Unity game engine ('Unity', 2020). Unity is a well-known game engine that can offer the ability to create different aspects of the game, such as the game scene and allows the application to run on various platforms such as IOS and Android. The application scripts and code are written in C# language through Microsoft Visual Studio, which enables linking them to the game objects in Unity. Unity has some shortcomings regarding compatibility with the Arabic language. Thus, Adobe XD was used to create the learning materials,

such as words and letters. The game icons and pictures were downloaded from royalty-free websites. However, some of the images required some adjustment regarding the regulation to allow them to be fitted into the application and needed to utilize Adobe Illustrator. Also, Adobe Illustrator can change the image format to be compatible with Unity.

7. The Game Scene

First, the user signs in by adding a username and a password. Then, a demo will play to illustrate the game interaction method and the main challenge of the game and how the user can finish the game cycle (Figure.2). After the demo, the screen will show three options to be chosen from, let's play, take the test and result. In let's play mode, the user must answer 28 multiple-choice questions to finish the game stage. Every correct answer will increase the progression bar; when they have seven correct answers, they will collect one star. Users in the playing mode must collect four stars to finish this stage. The application shows and articulates the word with a missing letter, and the user must drag the correct answer and drop it on the blank part of the word. If the answer is correct, immediate feedback will show that the answer is right with a cheering sound and fireworks. If the answer is wrong, reinforcement feedback will give users a visualized and sounded hint to show the user that their response is supposed to go with the hinted word (Figure.3). When the user finishes the game cycle, the overall feedback will appear to the user. The test mode is similar to the playing mode but with no reinforcement feedback. When the user has a negative attempt, immediate feedback will appear with an (X) symbol indicating their answer is wrong (Figure.4). If the answer is correct, immediate feedback will play a cheering sound with fireworks. By the end of the test, the overall feedback will appear to show the user their performance during the test. The user can access their results at any time through the results option on the main screen. The result screen offers users detailed feedback regarding their attempts in both playing and test modes.

Figure 2: The game Demo

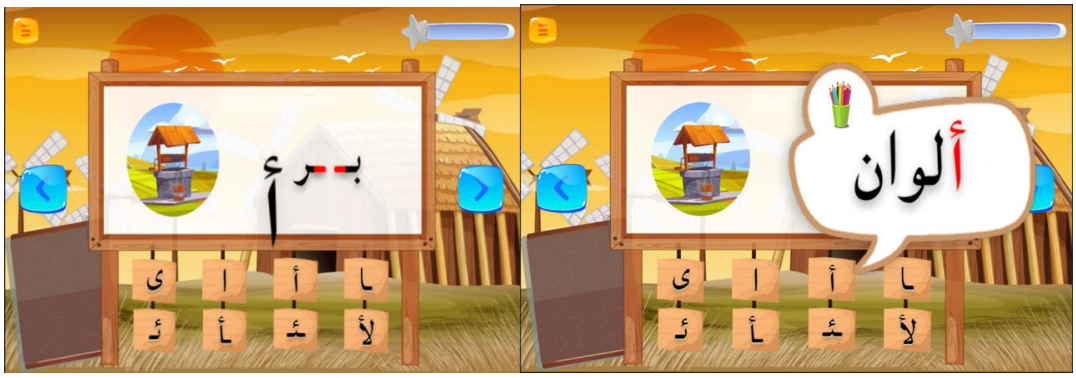

Figure 3: The wrong answer attempts with the reinforcement feedback in the playing mode. The figure on the right shows how the reinforcement feedback appears to the user

Figure 4: The immediate feedback during a wrong attempt in the test mode

8. Methodology

The study aimed to assess the effectiveness of the system in enhancing and boosting learners' comprehension of Arabic letters. To achieve this, a total of 75 native Arabic speakers enrolled in the first and second years participated in the experiment. The participants were divided into three groups to measure the differences between them. Specifically, the experiment and control groups consisted of 25 learners each from the first year, while the second-year group comprised 25 learners.

Before interacting with the application, the experiment group learners underwent a pre-test that assessed their knowledge of the characteristics of all Arabic letters. This pre-test served as a baseline measurement of their understanding. Subsequently, after engaging with the application, the experiment group learners completed a post-test to evaluate their progress and improvement in Arabic letter comprehension.

In parallel, the control group followed a similar process but instead of interacting with the application, they received traditional instruction from their teachers. They also took a pre-test and a post-test, which allowed for a comparison of their progress with that of the experiment group. The second-year group solely participated in the post-test since they were assumed to have a higher level of knowledge compared to the experiment and control groups due to being one year ahead in their studies.

The use of pre and post-tests enabled the researchers to effectively analyze and identify differences between the groups before and after exposure to either the application or the traditional learning approach. Both the pre-test and post-test included the various characteristics of Arabic letters described in section 3 of the study, allowing for an investigation into which specific aspects the learners exhibited the most improvement in. To analyze the quantitative data collected from the participants, IBM SPSS (Statistical Package for the Social Sciences) was utilized (IBM Corp, 2021). This statistical analysis software facilitated the examination of the data and enabled the researchers to draw meaningful conclusions regarding the effectiveness of the system in enhancing Arabic letter comprehension among the different groups.

9. Results

The study compared learners' grades before and after using the application or interacting with their teachers. The study compared both groups' pre-test to ensure that learners had a similar level of knowledge before taking the post-test. Then, the study compared all of the groups' post-test to spot any differences regarding their knowledge level and investigate if the application increased the learners' knowledge level regarding the Arabic letters. The reason behind the second-year group is to examine the application's ability to boost learners' level of comprehension of Arabic letters.

9.1 Differences Between Conditions in Pre-Test

To measure the differences between groups in the pre-test, a non-parametric Mann-Whitney U test is employed since the data is not normally distributed (Ruxton, 2006). Table 3 shows the differences between independent samples regarding pre-test scores. The results indicate no significant differences in the pre-test score between the experiment and control groups. The pre-test scores are (U=296.000, p=.744), and the p-value is greater than 0.05, which means that both groups had the same level of knowledge before taking the post-test.

Table 3: Results of Independent Samples Mann-Whitney Test for Differences between The Median and Mean Pre-test Scores for the two Groups (Experiment and Control)

Variable	Group	N	Mean	Std. Deviation	Median	Mean Rank	Sum of Ranks	U-Value	p-Value
Pre-Test	Experiment Group	25	5.64	1.551	6.00	26.16	654.00	296.000	.744
	Control Group	25	5.48	1.686	6.00	24.84	621.00		

9.2 Differences Between Experiment Group and Control Group in Post-Test

The Mann-Whitney U test is applied to measure the differences between two groups in the same condition. The results in Table 4 shows a significant difference between the control and the experiment group regarding the post-test score (U-184.500, p=.009). The p-value is less than 0.05, indicating that the experimental group performed better in the post-test.

Table 4: Results of Independent Samples Mann-Whitney Test for Differences between The Median and Mean Post-test Scores for the two Groups (Experiment and Control)

Variable	Group	N	Mean	Std. Deviation	Median	Mean Rank	Sum of Ranks	U-Value	p-Value
Post-Test	Experiment Group	25	7.24	1.268	8.00	30.62	765.50	184.500	.009
	Control Group	25	6.20	1.633	6.00	20.38	509.50		

9.3 Differences Between Experiment Group and Second-Year Group in Post-Test

Similar to the previous comparison, the Mann-Whitney U test has been applied to indicate the differences between both groups. Table 5 shows significant differences between the experiment and second-year groups (U=176.500, p=.005). This result suggests that the experiment group outperformed the second-year group since the p-value is less than 0.005.

Table 5: Results of Independent Samples Mann-Whitney Test for Differences between The Median and Mean Post-test Scores for the two Groups (Experiment and Second Year)

Variable	Group	N	Mean	Std. Deviation	Median	Mean Rank	Sum of Ranks	U-Value	p-Value
Post-Test	Experiment Group	25	7.24	1.268	8.00	30.94	773.50	176.500	.005
	2nd Year Group	25	6.32	1.574	7.00	20.06	501.50		

9.4 The differences between groups in correct and wrong answers

Both pre and post-tests contain all of the Arabic letters' characteristics. Table 6 shows the percentage of the learners' correct and wrong answers in pre and post-test regarding the Arabic letters' features. The results showed that the experiment group learners improved their performance in all Arabic alphabet aspects. Their performance was outstanding in the hamza, which is considered a confusing feature. The control group has slightly better achievement in some parts, such as letters allography and ligaturing. However, their post-test scores were lower in the letter similarity, with no change in hamza.

Table 7: The Average Score of All Groups Regarding the Arabic Letters' Characteristics

Group	Factor	Pre-Test Average Score		Post-Test Average Score	
		Correct	Wrong	Correct	Wrong
Experiment Group	Letters Similarity	88%	12%	96%	4%
	Allography	76%	24%	88%	12%

Group	Factor	Pre-Test Average Score		Post-Test Average Score	
		Correct	Wrong	Correct	Wrong
	Hamza	28%	72%	72%	28%
	Ligaturing	69.33%	30.67%	94.67%	5.33%
Control Group	Letters Similarity	84%	16%	82%	18%
	Allography	66%	34%	78.67%	21.33%
	Hamza	60%	40%	60%	40%
	Ligaturing	61.33%	38.67%	78.67%	21.33%
Second Year	Letters Similarity			88%	12%
	Allography			82%	18%
	Hamza			60%	40%
	Ligaturing			77.33%	22.67%

10. Discussion

This study investigates the system's ability to improve the learners' knowledge level of Arabic letters' characteristics. To assure the experiment's validity, pre and post-tests are applied in the study to allow group comparison. Learners had similar knowledge levels in Arabic letters in the pre-test. This step ensures no differences between groups before exposing them to the targeted learning method and taking the post-test. The post-test results of the experiment and the control groups showed a significant difference, and it emphasizes that learners who interacted with the system were able to improve their performance significantly more than learners who interacted with teachers traditionally. In addition, their performance was considerably better than the second-year group, whom it was assumed would have better knowledge than the control and experiment group. This result indicates the system's ability to boost learner performance regarding the targeted subject rapidly. Also, the experiment group students improved their knowledge of all the features and aspects of the Arabic alphabet. The experiment group learners improved their performance by 44% in Hamza. However, the control group learners performed better in the post-test, which tightened their knowledge with the second-year group. Also, they improved their performance regarding the allography and ligaturing of the Arabic letters, while their achievement remained the same in Hamza. This result might be related to the teachers' methods in delivering the learning content or the learners' class engagement level.

The research helps answer the first research question by demonstrating that the use of a touchscreen-based application has a positive impact on native Arabic-speaking learners' comprehension of Arabic letters. The study's findings indicate that learners who interacted with the application showed significant improvements in their knowledge of Arabic letters, thereby confirming the positive effect of the technology on comprehension. The second research question, which investigates the differences in Arabic letter comprehension between learners who use the touchscreen-based application and those who receive traditional instruction, is also addressed. The research findings reveal that the experimental group, which utilized the application, outperformed the control group that received traditional instruction. This provides empirical evidence of the superiority of the touchscreen-based approach in enhancing comprehension compared to traditional methods. The third research question explores the implications of incorporating gamification and interactive technologies, such as the touchscreen-based application, for language learning outcomes in elementary education settings. The research directly addresses this question by demonstrating that gamification elements and touchscreen technology positively influence language learning outcomes. The study highlights the potential of these technologies to engage and motivate learners effectively, resulting in improved language learning outcomes.

Overall, the implications of this experiment highlight the potential of incorporating touchscreen-based applications with gamified elements in language education, showcasing its positive effects on learning outcomes, motivation, engagement, and accessibility. This suggests that incorporating game elements in educational tools can help create an enjoyable and stimulating learning environment, potentially leading to increased learner interest and commitment to learning. These implications can guide educators, curriculum developers, and researchers in utilizing technology effectively to enhance language learning experiences. The research findings present opportunities for further investigations into the use of touchscreen-based applications and gamification in language education. This can encourage future studies to explore the impact of similar

interventions on other language skills and subjects, leading to the development of evidence-based practices for educational technology integration.

11. Conclusion

Based on the potential benefits of integrating touchscreen-based technology and gamification, an educational application was developed to assist learners in learning the Arabic alphabet's different forms. The application comprised multi-feedback techniques to assist learners while interacting with the learning content. The system was evaluated in terms of boosting and improving the learner's understanding of the Arabic letters. The application supports learners' learning of Arabic letters by giving them different forms of feedback to reinforce their performance. A total of 75 learners studying in their first and second year participated in the study, and they were divided into three groups (experiment, control, and second year). The experiment group outperformed both the control and the second year based on post-test results. In addition, they improved their comprehension of all Arabic letters' characteristics. The control and second-year groups had no significant differences regarding their post-test results. In addition, the control group improved their understanding of only two characteristics of the Arabic letters. These results indicate that integrating gamification elements and touchscreen devices and offering learners different types of feedback can positively and considerably influence learner achievement and performance. In future, we will consider fine-tuning gamification elements, personalizing learning paths, conducting cross-cultural studies, integrating these tools into formal education systems, and inclusivity, enhancing assessment and feedback mechanisms, and exploring multilingual applications. These research directions aim to optimize the effectiveness and inclusivity of touchscreen-based learning, making it a valuable tool for educators and learners worldwide.

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