



Serious game design model for language learning in the cultural context

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Abstract

Digital learning environments have been gaining prominence during the last few years. In particular, the rising usage of mobile devices, including smartphones and tabs, has invited researchers to design and develop learning applications and games for such platforms. Mobile applications and games have been developed for learning languages like many other domains. However, most of these games are fun-based and lack a holistic design and development approach. Therefore, as a principal contribution, this research presents a theoretical model for designing language learning games in a cultural context. The proposed model combines the elements of sociocultural theory with the concepts and elements of gamification, keeping in view the requirements and educational settings, including level and mode of education, etc., to ensure the effectiveness and usability of the developed game. Subsequently, based on the proposed model, a Language Learning Game (LLG) has been designed and developed through a systematic process that involves game design, low-fidelity, and high-fidelity prototyping and its validation. The LLG has been evaluated comprehensively at different stages by incorporating standard methods. Whereby this research augments the existing set of heuristics by proposing a number of specialized heuristics for the evaluation of serious games to gauge their conformance to the cultural context. The evaluation results show that the game has overall usability scores of 90%. While the quasi-experiment-based pre-test and post-test have been conducted, the results reveal that the results obtained by LLG are statistically significantly better than adopted mobile application and traditional group.

Keywords Digital games · Effectiveness · Gamification · Serious game · Heuristic evaluation · Think-aloud · Prototype

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1 Introduction

Recently, digital games have been broadly used in academia to improve language learning, which students consider enjoyable. Learning through games provides learners with a friendly environment as they find it enjoyable and useful for achieving the learning outcomes. Learning games also called serious games, provide the teachers with the facility of repeating and recalling the concepts where memorization is the requirement for language learning and improves their learning skills (Müller et al., 2018). Serious games are digital games prepared for educational purposes more than entertainment and are more effective than other games. There are several applications for these games in various industries, such as military, healthcare, education, research, manufacturing, and more (Tek et al., 2021). These games strive to form a high-quality mood to inspire gamers to proceed with the play, leading to accelerated pastimes in gameplay and better educational performances to produce good results. The pioneering studies in Malone (1980) define the purpose of these games to create awareness in an educational context to see the impact of learners' motivation, social influence, and engagement (Zainuddin et al., 2020; Zhonggen, 2019). According to Furtado et al. (2018) and Juan et al. (2017), serious games are remarked as diverting tools with the purpose of education. The players cultivate their data and score their performances by applying their skills through this interactive activity.

Language is an integral part of a culture, and a child starts learning mother-tongue through his environment and family. Similarly, the acquisition of a second language is also influenced by culture. English is the most commonly used language in the world for a variety of reasons, including communication, education, business, and technology. The expanding significance and need of the English language in the modern era have elevated it to a mandatory prerequisite for today's learners. It is considered a second language in most countries, and also it is perceived as an essential instrument to survive in the universal economy (Nawab, 2012).

Many different researches have been carried out to design applications and games for learning a language in different cultural contexts (Holden & Sykes, 2011; Hwang et al., 2015; Ishaq et al., 2021a; Kuo & Lai, 2006; Lee et al., 2011) as regional factors influence the teaching and learning methods (Ishaq et al., 2021a; Terry & Cheney, 2016). Various authors discussed considering localized content for language learning in their cultural context (Edge et al., 2011; Elaish et al., 2019a; Marx & Pray, 2011; Tshering et al., 2018; Wierzbicka, 1985). Most of the games are fun-based and have not been developed by involving a model/framework that provides holistic support for designing and developing a culturally tailored serious game for language learning (Ishaq et al., 2021a).

The idea of learning language through mobile games involves some important aspects, including content based on the targeted level of education, gamification elements, principles, and the users' cultural context. Hence, there is a need to tailor a specialized model that combines the strengths of existing generic, gamified, and language learning models to fulfill the needs of a culturally tailored

language learning serious game. Apart from this, there is a stringent need to identify the requirements related to the usability, content, and assessments by keeping in view the cultural context. It is significant to note that the cultural context plays a vital role in adopting a language learning game (Quiñones & Rusu, 2017). Hence, gathering requirements in different important heads while considering cultural context is very important for comprehensively designing and developing such a game. Therefore, this research aims to present a serious game design model for language learning in a cultural context along with its validation and experimentation.

Similarly, the cultural context refers to the setting in which individuals are raised and how culture affects their behaviors. This concept combines the values that are taught and the attitudes that are reflected among different social groups. It includes beliefs, values, customs, ideas, language, and norms (Kakita & Palukuri, 2020). Social and psychological settings act as gateways to the cultural environment. Cultural aspects such as views, ideas, behaviors, and abilities may develop in individuals due to their socialization experiences, including interactions with different cultures (Allwood, 1990). Games for a cultural context are necessary to follow a model/framework to positively impact students' learning with reference to comprehension and many other learning areas in English language learning (Stevick, 1982). It is necessary to consider localized content, color scheme, and images while developing a game in a cultural context because people live in different cultural settings across the region. Their local cultural viewpoint strongly influences the requirements for such games (Díaz et al., 2017). Therefore, there is a need to develop a theoretical model for language learning in a cultural context incorporating pronunciation, vocabulary, content, assessment, gamification elements, educational settings, and usability guidelines (Ishaq et al., 2021a).

This research presents the outcomes of a longitudinal study that starts with proposing and validating a holistic model for a culturally tailored language learning game. Subsequently, a language learning serious game has been designed, developed, validated, and evaluated based on the proposed model. The whole process involves validating the model and designing & validating low and high-fidelity prototypes. Whereby it not only uses existing standard heuristics but also extends these existing set of heuristics by extending these specialized heuristics with the ones required to validate cultural context. Furthermore, the developed game was evaluated through a quasi-experiment involving teachers and students of the public sector schools. This study aligned the following research questions:

1. What should be the constructs of a culturally tailored serious game-based language learning model?
2. How can we evaluate the efficacy of the proposed model?

This article has been structured in the following sections. The detailed literature review has been presented in Section 2, which discusses the previous studies based on the impact of culture in language learning and serious games for language learning. The proposed model for designing a culturally tailored serious

game has been presented in Section 3. The details about the design, low-fidelity and high-fidelity prototypes, have been given in Section 4. The details of the experimental setup and discussion about the results have been presented in Section 5. Whereas the article has been concluded in Section 6.

2 Literature review

This section presents the relevant literature about cultural context, factors for language learning, serious games concerning language learning, design model, and the game developed by the researcher along with its validation.

2.1 Cultural context with its impact and factors for language learning

“Culture is defined as the ideas, customs, skills, arts, and tools that characterize a given group of people in a given period of time. But culture is more than the sum of its parts (Brown, 1981).” Cultural context refers to the environment in which people are reared and how that culture influences behaviors. Cultural aspects like beliefs, ideas, behaviors, and competencies may emerge in people based on their socialization, involving interacting with other cultures. It helps us think, influences our feelings, and informs us on how to interact with others, especially in regard to interpersonal relationships. Values that are taught and attitudes expressed between individuals are brought together in this concept (Kakita & Palukuri, 2020; Tomasello et al., 1993). According to Vygotsky’s sociocultural theory, children learn cultural norms, beliefs, and problem-solving methods via collaborative conversations with more experienced people in society (McLeod, 2008). A sociocultural approach to language and learning includes a specific understanding of how language and social interaction are engaged in human growth and learning processes. A sociocultural perspective on language states that individuals create meanings through communication, and these meanings are not only dependent on the words used (Hicks, 1995). Sociocultural factors like social interaction, language, culture, self-efficacy, and the scaffolding also influence the teaching and learning process for the target language learning (Ishaq et al., 2021a; Pazyura, 2016; Terry & Cheney, 2016).

Language learning is a process that takes time, even under ideal conditions, when the learner is determined and equipped with everything necessary to succeed. It is important to recognize that language acquisition is never just a language process. It is influenced by various sociocultural and psychological variables particular to every learner. Preceding information, attitudes, personality, learning styles and abilities, and motivation influence language learning (Rustipa, 2015). Similarly, the acquisition of a second language is also influenced by the culture, whereas many different studies designed games and applications for learning the English language in their respective culture (Hwang et al., 2015; Kuo & Lai, 2006; Lee et al., 2011). Various authors discussed considering localized content for language learning in their cultural context (Edge et al., 2011; Elaish et al., 2019a; Marx & Pray, 2011; Tshering et al., 2018; Wierzbicka, 1985).

Culture affects not only people's values and customs but also their language and behavior. Language proficiency requires cultural knowledge, and a society's culture can change depending on the language employed (Kuo & Lai, 2006). The cultural background is essential for learning and mastering a language (Stagich, 1995). It is thought that a person's cultural background and language are interdependent and can be described as two sides of the same coin, so language is not free of culture. It should be considered necessary elements of second language learning while learning a new language without knowledge of its culture remains incomplete (Mohammad, 2020). The language defines a cultural group and distinguishes it from others (Alméciga & Lobatón, 2010) as language is a product and a symbol of culture (Mohammad, 2020). Language expansion typically impacts culture, and it is often explicitly coded with cultural patterns of thought and tradition (Armour-Thomas, & Gopaul-McNicol, 1998).

Teaching English as a second or foreign language in non-English countries is challenging (Ishaq et al., 2021a). In many Arabic countries, it is not widely spoken in daily life. According to Elaish et al. (2018), children in Yemen and Saudi Arabia started learning English in seventh grade. Learning vocabulary in the English language is important, but Arabic students felt hesitant to converse in English because of their restricted vocabulary (ALQAHTANI, 2015). As a result, they avoid lengthy interactions and lack the true desire to learn a foreign language (Muhammad, 2011). The study of Elaish et al. (2019b) and Al-Johali (2019) demonstrated barriers concerning the pedagogical skills, teaching methodology, and learning environment in speaking English as a Second Language. Students lack the necessary drive to study English, which is often mandatory since their ability level is incompatible with the challenge of learning (Aboraya & Elkot, 2020; Tuloli et al., 2019). The most common issue encountered by English language learners is a lack of motivation (Islami, 2020; Shahrol et al., 2020). There are a lot of factors influencing language learning in the cultural context as the cultural aspect has major significance, and without it, no language can be acquired.

People from various parts of the globe have diverse cultural origins and speak multiple languages (Kuo & Lai, 2006). According to Gleason Jr. (1955), languages are not only products of civilizations but also cultural symbols, and these languages are influenced by culture. The study of i-Pons (1964) described if some aspects of a language are significantly different from the learner's primary language, the student is likely to have problems learning the language. The study of Khan and Khan (2016) explored major factors that raised hindrances in learning the English language, which is: the contrary strategies of the government, non-availability of modern teaching technology in the public sector, non-supportive behavior of parents, non-availability of English teachers, lengthy & outdated curriculum, and outdated examination system. The biased approach toward English, the absence of adequate educational technology, intrusion of the mother tongue are also the major factors. Similarly, lack of vocabulary and grammar, issues in spelling, discouraging behavior of teachers, family background, overcrowded classes, lack of teachers' training, education of parents, and ruthless behavior of teachers creates hurdles in learning the English language (Ad et al., 2014; Aziz et al., 2015; González-Valencia et al., 2020; Khan et al., 2020; Mohammadian

et al., 2018; Rahman, 2008; Sarwar et al., 2017; Shamim, 2008; Taj et al., 2017; Tariq et al., 2013; Viberg et al., 2020).

2.2 Serious game and language learning

Serious games are digital games used for education, training, rehabilitation, and other purposes. Effective serious games strive to form a high-quality mood to inspire gamers to proceed with the play, primarily to accelerated leisure in gameplay and better educational performances to produce good results. Happy and energetic gamers absorb serious game-assisted learning learn significantly longer than non-game-based learning (Zhonggen, 2019). According to Wang et al. (2016), a serious game is a helping tool to integrate into many subjects as it plays a vital role for learners and in learning the targeted subject. These games are easy to use, effective, and useful to satisfy the learner's need, which was confirmed by the survey group of participants (Ishaq et al., 2021a). The concept of serious games has already been widely accepted in various subjects to play a vital role in effective language learning (Wang et al., 2016). For learning the language, serious games offer a full scope of talents with their wealthy linguistic, content, and engaging audiovisual mechanisms among the young generation (Alyaz et al., 2017). Furthermore, these games are able to boost the learner's inspiration and interest in language learning (e.g., journey German, SiLang, Language lure, and DigiBahn) are examples (Giessen, 2015). Similarly, the game "The Mystery of the Sky Disc" can be played to learn German, English, and Turkish language (Alyaz et al., 2017).

This study conducted by Dourda et al. (2014) suggested a game-based concept for Greek primary schools to teach language learning. The selection of this game was due to the authenticity of material for a meaningful purpose, easy-to-use panel, and attractive graphical interface. Alyaz et al. (2017) described 110 German mobile applications, including language learning games with the content in grammar and vocabulary. Similarly, two applications, 'PHONE Words' and 'Word Score,' were developed for vocabulary acquisition, with and without gaming elements, to analyze and measure users' learning performance (Chen et al., 2019; Fisser et al., 2013). The company behind the game-based software 'SOS Table' created it to practice phrase string repetition, high-frequency vocabulary, and tenses. After completing the activity, participants were tasked with producing negative, positive, or correct statements using phrases and pronunciation (Önal et al., 2019). Additionally, a game-based application named 'Idiomobile' was developed for various devices using idiomatic terms (Amer, 2014). In the study by Holden and Sykes (2011), a Spanish language learning game based on augmented reality was created to examine the advantages and difficulties of learning a foreign or second language. Other gamified applications for English vocabulary learning (Sandberg, 2011; Wu, 2018), Spanish language learning (Holden & Sykes, 2011), Vocabulary, Grammar, and Sentence Structure (Tsai et al., 2017), and Tenses, Words, Sentences (Önal et al., 2019) had also been proposed. The research which used gamification to increase learning outcomes in the areas of

Table 1 Summary of Some Existing Applications, Games, and Evaluation Measures for Language Learning

Source	Country / Culture	Aim	Game or App	Theory/Approach	Discussion
(Elaish et al., 2019a)	Saudi Arab	English Vocabulary	Application	Sociocultural theory	The framework adopted socio-cultural theory to develop English vocabulary application for Saudi cultural context students, but the model and application was not validated through any formal method (i.e., IRR / HE).
(Ashraf et al., 2014)	Iran	English Vocabulary	Online computer game	N/A	This study reported the usefulness of online games for vocabulary learning without any theory, model, or framework. The study used a quasi-experimental method to see the usefulness of games between the groups.
(Ibrahim, 2017)	Sudan	English language teaching	N/A	N/A	This study did not follow any theory or framework except to administer a questionnaire to see the improvement through games empirically.
(Chen, 2016)	China	English language learning	Application	Framework consisting theory and pedagogical dimension used	This study used a theoretical framework to evaluate social interactionist theory and affective filter hypotheses to evaluate English language learning applications.

Table 1 (continued)

Source	Country / Culture	Aim	Game or App	Theory/Approach	Discussion
(Zhang, 2016)	China	Practice Oral English	Application	N/A	An application was designed for oral English by the Chinese Science Tech company without following any model, framework, or theory, whereas a questionnaire was administered to see the effect of the application on English language learning.
(Hwang et al., 2015)	Taiwan	Listening and Speaking English	Application	N/A	This study proposed a game-based learning activity to enhance listening and speaking skills in a situational context.
(Meyer, 2009)	Denmark	Learning English online	Application	Theoretical framework (discussed only)	This study discussed a framework, also a game 'Mingoville' for user engagement, performance, and design in online English language teaching and learning.
(Vasileiadou, & Makrina, 2017)	Greece	English Vocabulary	Computer game	N/A	The purpose of the study was to see the effectiveness and motivation of computer games for the English language without any model, framework, or theory.

Table 1 (continued)

Source	Country / Culture	Aim	Game or App	Theory/Approach	Discussion
(Supuran, & Sturza, 2017)	Romania	English for environmental science	Online computer game	N/A	This study introduced a serious games toolbox for teachers to practice English for a specific purpose without a model, framework, or theory.
(Casañ Pitarch, 2018)	Spain	English grammar and Vocabulary	N/A	Theoretical background discussed only	This study explained the theoretical knowledge of grammar and vocabulary by discussing basic concepts of gamification and theoretical principles of language learning through video games.
(Lee et al., 2011)	Korea	Dialogue speaking	Game	N/A	This study discussed spoken dialog-based language learning games to communicate characters in post offices, libraries, shops, and streets. An experiment consisting of pre-test and post-test was conducted.
(Tshering et al., 2018)	Bhutan	Spellings	Game	N/A	This study presented a spelling game, 'EDUBUZZ kids', to develop another application for learning a national language. The author did not follow any model, framework, or theory for the purpose.

Table 1 (continued)

Source	Country / Culture	Aim	Game or App	Theory/Approach	Discussion
(Burian et al., 2019)	Finland	Karelian language	Game	N/A	This research discussed a game prototype, 'Let's Learn Karelian' for Finnish language in a culture without following a model, framework, or theory.

vocabulary, idioms, grammar, sentence structure, tenses, and terms demonstrated far better results than the control groups (Dichev & Dicheva, 2017; Ishaq et al., 2021a; Jaafar et al., 2009; Zin and Yue, 2013).

Table 1 summarizes language learning games aiming at different aspects of language learning in various cultures. The designing and development of such games require frameworks that provide guiding principles to build a comprehensive product. Many generic frameworks and models have been proposed for educational games in general, mobile games, and language learning for mobile applications (Hermawati & Lawson, 2016; Ishaq et al., 2021a; Quiñones & Rusu, 2017). The closest model is available of Elaish et al. (2019a) for English vocabulary in the Arab context. However, there are some limitations in this model from the following perspectives: (a) specific requirement gathering by engaging the relevant stakeholders; (b) missing usability perspective; (c) no structured approach for gamification; (d) the proposed model has not been validated.

3 Serious game design model for language learning (KSGDM)

A framework for developing serious games includes all of these factors, including various game kinds, flexibility for change, and the capacity to evaluate, study, and enhance the learning process (*S.G. Framework* (n.d.)). Serious game design frameworks and methods help developers to collaborate on a cohesive solution (Jaccard et al., 2021). The researchers proposed various serious game design models and frameworks for language learning (Ahres, 2017; Cano et al., 2015; Elaish et al., 2019a; Ibrahim & Jaafar, 2009), but serious attention was required on serious game design model for language learning in a cultural context. Therefore, this study proposed a serious game design model for language learning in a cultural context by combining the elements: requirements, educational settings, socio-cultural aspect, gamification constructs, and usability (usability guidelines and usability testing) as given in Fig. 1. The domain experts reviewed and validated the model through inter-rater reliability (IRR). IRR refers to the degree of agreement between raters or judges (Glen, 2016). If everyone agrees, IRR is 1 (or 100%), and if everyone disagrees, IRR is 0 (0%). Several experts have concluded that a 75%–90% consent percentage was an appropriate agreement level (Belotto 2018; Gisev et al., 2013; Tap et al., 2021).

3.1 Components for serious game design model

This section presents the components of the theoretical model: academic requirement, educational settings, sociocultural theory, gamification, and usability. These components are important for a serious game design model for language learning in the cultural context of Pakistan, for which the detail is given in the following section.

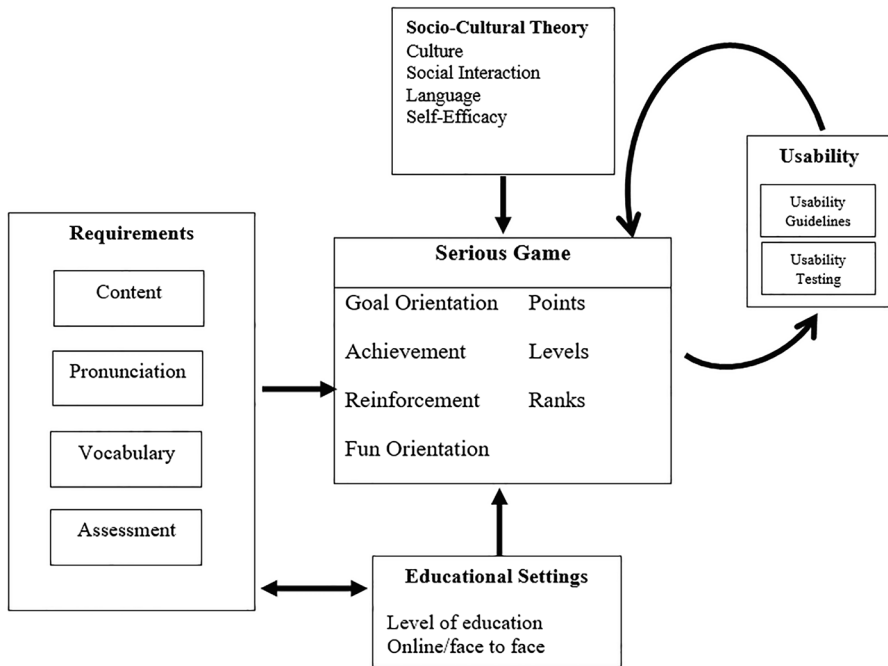


Fig. 1 KSADM model for Serious game design in a cultural context

3.1.1 Academic requirements

Pronunciation The model considers pronunciation an important ingredient for serious game-based language learning. Since pronunciation is the recognized method of speaking a word, while it is the act or style of saying a word (Otlowski, 1998; Rippell, 2012), additionally, it may be described as the generally recognized sound and rhythm standard for words in a particular language. Furthermore, the model also considers that pronunciation is a critical component of the English language, i.e., when students talk, read, or listen in English, they often encounter pronunciation difficulties (Praistiana & Budiharto, 2020). It is self-evident that someone with poor pronunciation would be unable to communicate effectively and properly. Thus, it is essential to master proper pronunciation, despite its complexity and difficulty (Cavus, 2016). The study of Golonka et al. (2014); Zhang and Zou (2020) found pronunciation effective for learning the English language through technology with positive feedback even in Pakistani culture (Riaz, 2021; Zahoor & Kausar, 2018).

Vocabulary Vocabulary is an integral part of a language and is considered an essential academic requirement of the model, whereas acquiring new vocabulary is a critical component of language education (Perveen et al., 2016; Zou et al., 2019). There are multiple aspects to learning a new word in a language: it is necessary to spell and pronounce the word correctly. Further, it is needed to understand the word's true

meaning. Top of all, it is important to be aware of the different uses and connotations that the word has (Yang et al., 2020).

Content Content is an important part of an educational game. It is also considered an important requirement in the model because it is designed to assist students in understanding certain topics or things. As a result, the learning material of the game should be as aligned with the learning goals as feasible to accomplish learning objectives. Gamifying the content is a greater incentive for the learner to learn a language to make it enjoyable for the students in their context (Ibrahim & Jaafar, 2009; Perveen et al., 2016). It involves mapping the syllabus material of the class into the game for a setting in which to practice what was learned, for self-learning, and for open-ended interactions that help students improve their motivation. Thus, game-based learning may help students achieve the objective of effective learning in a dynamic setting (Perveen et al., 2016; Sun & Yeh, 2017). This theoretical model is generic. Any content related to language learning of a local cultural context could be added, but this study's scope is limited to English comprehension.

Assessment The academic assessment requirement is an essential component of the model. The evaluation matrix may be used to evaluate the result of a gamified learning environment to determine the advantages of gamification in education. The primary aim of gamification in education is to engage students to improve their learning performance (McGonigal, 2011; Nah et al., 2013; Reeves & Read, 2009). In addition, it is expected that students' learning ability could be assessed through practices, quizzes, and the results of gamification, all of which contribute to students' satisfaction levels (Ishaq et al., 2021a). Assessment elements added to game-based learning environments should be included as early in the design phase as possible since this adds a significant amount of time to the design process (Su & Zou, 2020).

Others With the emerging trends of gamification in education, it is found that students perform better in analytical reasoning, critical thinking, mathematics, and processing speed who plays learning games consistently. This element could be adopted in the theoretical model to add more challenges to developing cognitive ability, making learning performance better for a student (Todorov, 2021). Similarly, there are several methods for teaching a subject or concept adopted in institutes by the instructors. These methods contain increasing difficulty levels, revisiting topics during learning, and reinforcement (Han, 2015). During the development of language learning games, these pedagogical methods can be involved to enhance students' engagement.

3.1.2 Educational settings

This section presents the level of education and the teaching method in Pakistan's cultural context.

Level of education The level of education is crucial for a language learning serious game because it is important to consider which level the game is developing. In Pakistan, education level consists of multiple levels, i.e., Primary, Elementary, Secondary, Higher Secondary, Graduation, and Post-Graduation (*Pakistan Economic Survey*, 2018). The culture is needed to be considered while teaching through technology to the students (Byram, 1994; LUIS, 2017), and it is necessary to consider the level of education in a cultural context for developing a language learning game (Curtis, 1999; Wright et al., 2005).

Face to face or online There are a lot of teaching methods adopted in the institutions for delivering lectures but mostly face-to-face teaching methods adopted in Pakistani institutes (schools, colleges, and universities), whereas the trend of online teaching is also encouraging due to the COVID-19 pandemic. An appropriate teaching method should be focused on developing a game for language learning (Lathan, 2021; Shahzad et al., 2020; Wright et al., 2005).

3.1.3 Sociocultural theory

According to Vygotskian theory, Vygotsky and Cole (1978), sociocultural theory (SCT) asserts that language acquisition is a socially mediated process. Language is a cultural artifact that mediates social and psychological processes. When it comes to teaching children at the early foundations of language, it is the process of meaning-making via participation in a cultural activity that counts. The researcher argues that the SCT principles may also be used in the serious game design model for language acquisition in a cultural setting since (Menezes, 2013) emphasizes that SCT is based on a viewpoint that does not compartmentalize the person from society. A school of thought holds that the person arises through social interaction and is always a social creature. Language learners watch and mimic others as they communicate in the social environment.

Additionally, learners go through stages with the assistance of other social actors. Vygotsky's theory emphasized the significance of play in learning. Teachers and parents may use this information by giving enough chances for children to engage in play. Vygotsky thought that children might expand their mental skills and understanding of the world via play and imagination. Imaginary play, role-playing, games, and reenactments of actual events are examples of types of play that may support learning. These activities contribute to the development of abstract thinking (Menezes, 2013).

As another Vygotskian term, “scaffolding” may be defined as a person's help and support from another individual (i.e., teachers, family, and classmates), which helps them acquire new ideas. Teachers are able to arrange their teaching and courses in advance. For instance, the instructor may divide the class into groups in which students with lower skill levels are matched with students with higher ability levels. Children's skill levels may be increased via hints, prompts, and direct teaching. Teachers may use the idea of scaffolding, where the instructor offers help by setting up situations for students to complete while they work

towards a certain objective (Menezes, 2013). The study of Byram (1994), LUIS (2017), Mahmood et al. (2012) emphasized considering the culture while learning a language through technology.

A significant component of the proposed model is a sociocultural context that impacts culturally tailored serious games for language learning. The model's components in Fig. 1 are: academic requirements, educational settings, gamification, and usability influenced by sociocultural aspects. The following points describe its influence:

Culture The cultural element strongly influences learning a language through the game. The cultural context is given serious consideration in designing the game, particularly for setting up the content, look and feel, teaching methodology, pronunciation, etc. In terms of look and feel, a country's local culture is important to present along with the dress code for the characters because the dress code of western civilization (movies, cartoons, and drama) is uncommon to the local settings of Pakistan. Various authors emphasized considering localized content for language learning in the cultural context because every culture has different learning settings. For instance, the naming convention in the game should be according to the local settings because naming conventions of Western civilization are uncommon in Pakistan's regional settings. Similarly, the names of characters, places, and stories (folktales) in the comprehension paragraphs must be localized to keep the game interesting and engaging for the desired learning outcome. Likewise, the teaching method should also focus on the local settings because each country has its teaching methods in the classroom and way of dealing with the students. The accent for pronouncing a word should be adjusted to the local settings because the western culture accent is not understandable to people of eastern culture. Therefore, it is recommended to keep in mind the cultural aspect while developing a game for language learning for a specific country because every country has different norms, traditions, and settings.

Social interaction The development of cognition is significantly influenced by social interaction. Every function in a child's cultural development is represented twice: on the social and individual levels (between people and then inside the child). In the cultural context of game development, the background settings influence the child by developing interest and engagement for learning through games.

Language Sociocultural aspects highlight the significance of context in language learning, while second language learning focuses on how people learn a language other than their mother tongue. The sociocultural context in language research provides a paradigm for rigorously investigating human thought without separating it from its social environment (Lantolf & Thorne, 2006; Mustafa et al., 2017). The process of meaning-making through collaborative engagement with other members of a particular culture produces second language learners (Vygotsky & Cole, 1978). As a result, sociocultural approaches emphasize how someone acts, where they act, and why they act. SCT considers the complex interactions between the person acting with moderation methods and the sociocultural environment, while other viewpoints

concentrate on the individual and what the individual is doing (Lantolf & Thorne, 2006).

Self-efficacy It is referred to as individuals' confidence in their capacity to accomplish a task or achieve a goal. Self-efficacy is an important element in the sociocultural context as it has a significant impact on how much effort people put into an activity. Someone with strong self-efficacy for a task will be robust and consistent in the face of difficulties, whereas someone with low self-efficacy for the activity would withdraw or escape the situation. Some students may avoid taking difficult math courses if they have poor self-efficacy.

The SCT theory's main emphasis is on learners' mental activities like thinking, knowing, memorizing, and problem-solving, creating knowledge through collaborative learning by communicating and interacting with other students. It also stresses that learners are trained to do tasks and solve problems by using their possible solutions with the help of teachers. Students learn from their social world by observation and imitation to develop new knowledge. Through social contact and cooperation with others, learners are able to build new knowledge and skills. They develop their new knowledge with the assistance of other students, the environment, and the learning context (Scott & Palincsar, 2013).

The study of Snow (2002) highlighted factors that affect students' understanding within the sociocultural environment. According to him, comprehension results from a complicated combination of many interacting variables that must be addressed separately or in combination when designing guidelines (Davis, 2014; Woolley, 2011). The first element is the sociocultural context, which encompasses all cultural practices occurring inside the learning environment, such as the learners, the classroom, and the lesson's learning goals. The classroom setting and instructional goals provide a sociocultural environment in which meaning is constructed. The text, activity, and reader are all examples of this. In the United States, 42% of school-aged children fail to go beyond basic levels of comprehension. Minority kids and children from low-income families score significantly poorly on standardized tests of comprehension ability (Perie et al., 2005).

English comprehension, specifically, is the study of the impact of instructional reading methods on the comprehension improvement of English language learners (Purpura, 1998). Several studies have examined the impact of learning various strategies on improving students' comprehension abilities, resulting from these strategies helping poor students improve their comprehension abilities (Lantolf & Thorne, 2006). Researchers believe that new technologies, like games and word processors, may be utilized as analytical tools to help students develop new abilities and habits. As a result, learners may adopt new technologies to establish adaptive learning platforms that facilitate comprehension learning (Scott & Palincsar, 2013).

All main ideas of the theory are consistent with the proposed learning game model, i.e., outcome expectations, perceived self-efficacy, observational learning/modeling, self-regulation, goal setting, and learning to live in the social world. Through games, students learn the English language by using a problem-solving technique with the help of teachers and peers. This technique enabled them to transfer, remember, and recall knowledge in learners' memory. It also builds intrinsic

motivation in students by integrating learning with game experiences developing all the above characteristics in students. Figure 1 presented the mapping of SCT theory with the serious game design model for language learning in a cultural context.

3.1.4 Gamification constructs

The gamification components are taken from Ahmad et al. (2020), which provides recommendations for developing gamified apps in educational contexts. Four main components exist: a) goal orientation, b) accomplishments, c) reinforcements, and d) a fun orientation. In the theoretical model, academic requirements, educational settings, and sociocultural theory elements joined together through gamification to develop a serious game for language learning in a cultural context.

Goal orientation A structured environment for educational gaming may have various learning goals, and each learning goal should be segmented into smaller tasks (Danelid & Fältman, 2021). It is necessary to consider this element in the model to get the desired learning outcome of the student.

Achievements When students are recognized for their accomplishments, they experience a feeling of accomplishment, leading to greater engagement and motivation (Monteiro et al., 2021). It is necessary to consider this element in the model to provide stars or prizes on completing the exercises for engagement and motivation.

Reinforcement A paradigm that claims that learning occurs via negative and positive reinforcements is the psychological behavior learning model (Ahmad et al., 2020). Additionally, negative reinforcements such as time delays to the next level, virtual life loss, or progress loss provide students with corrected information or knowledge and a method to learn from their errors, allowing them to learn more successfully (Limantara et al., 2020). It is a necessary element to permit the student to revisit the topic on the failure for learning.

Fun orientation Engagement is positively related to enjoyment in any activity, and mostly all games have pleasure or enjoyment elements for their players to keep them engaged (Bursztyn et al., 2019). It is an important element in the model for developing a serious game to include an aspect of pleasure or fun to engage students to achieve learning outcomes effectively. In a cultural context, the flow of the game and localized comic character keeps the student interested, whereas accomplishment of a stage in a game: levels, points, ranks, and reward amuse the player to keep them engaging for learning more and more (Díaz et al., 2017).

3.1.5 Usability guidelines and testing

Usability is a criterion of how productively, effectively, and successfully a certain user can utilize a design or product in a particular environment. Developers

typically evaluated the design's usability from prototype to final deliverables during the development phase to guarantee optimum usability. For this purpose, necessary usability guidelines needed to be followed to develop an effective gamified application for language learning. These usability guidelines consisted of the elements: Chrome (visual design), gestures, progressive disclosure, download time, interaction cost, early registration must die, workflow design, and writing for mobile defined by (Nielsen & Budiu, 2013).

Usability testing is a method to evaluate the effectiveness of a prototype through a certain approach, i.e., heuristic evaluation, think-aloud, and observations (Nielsen, 1994a). It is necessary to develop or adopt heuristics for a game or application to evaluate it from the stakeholders (Alserri et al., 2020; Hermawati & Lawson, 2016; Mohamed & Jaafar, 2010a; Mohamed & Jaafar, 2010b; Quiñones & Rusu, 2017; Röcker & Haar, 2006; Sivaji et al., 2011). The proposed heuristics for language learning games in a cultural context are given in Ishaq et al. (2021b).

3.1.6 Validation of theoretical model

The Inter-Rater Reliability (IRR) utilized in this study was the percentage acceptance agreement. Several experts had concluded that a 75%–90% consent percentage was an appropriate agreement level (Belotto 2018; Gisev et al., 2013; Tap et al., 2021). Table 2 presents the expert's theoretical model analysis for game design and its components. The resultant IRR approval for the model was 0.90 (90%), which showed high reliability and consistency.

Table 3 illustrates the analyzed comments provided by the experts during the validation of the model. They recommended adding pronunciation on all the learning screens, whether words or sentences. So, it is easy to learn the pronunciation of each word; furthermore, on the multiple errors while solving the exercise, the student should take back to repeat the lesson. Importantly, the teachers/experts and the students must evaluate the high-fidelity prototypes because they could point out the complications at their level to make the game better.

4 Serious game for language learning

This section presents the game's design named 'LANGUAGE LEARNING GAME (LLG)' using the KSGDM model. The LLG aims to support learning the English language in the cultural context of Pakistan. This prototype has been developed based on the proposed theoretical model and has been extensively evaluated by engaging a considerable sample of public sector primary school students. The design of LLG strictly involves the components of the proposed theoretical model, including the user requirements, serious game elements, sociocultural theory, educational settings, and usability guidelines (also testing). LLG has been developed from the planning to the testing stage as a software project. First, the requirements were gathered from the stakeholders through a preliminary survey and the literature review to design the interfaces and modules by considering the elements of the theoretical model. Later on, the development (coding) of the game was performed using the

Table 2 Experts Agreement Analysis

No.	Components	EXPERT				AB	AC	AD	BC	BD	CD	Level of Agreement	No. of Agree-ments
		A	B	C	D								
1	Content	1	1	1	1	1	1	1	1	1	1	6/6	6
2	Pronunciation	1	1	1	1	1	1	1	1	1	1	6/6	6
3	Vocabulary	1	1	1	1	1	1	1	1	1	1	6/6	6
4	Assessment	1	1	1	1	1	1	1	1	1	1	6/6	6
5	SC Theory	1	1	1	1	1	1	1	1	1	1	6/6	6
6	Goal Orientation	1	1	1	1	1	1	1	1	1	1	6/6	6
7	Achievement	1	1	1	1	1	1	1	1	1	1	6/6	6
8	Reinforcement	1	1	0	1	1	0	1	0	1	0	3/6	3
9	Fun Orientation	1	1	1	1	1	1	1	1	1	1	6/6	6
10	Points	1	1	1	1	1	1	1	1	1	1	6/6	6
11	Levels	1	0	1	1	0	1	1	0	0	1	3/6	3
12	Ranks	1	1	1	1	1	1	1	1	1	1	6/6	6
13	Usability Guidelines	1	1	1	1	1	1	1	1	1	1	6/6	6
14	Usability Testing	1	1	1	1	1	1	1	1	1	1	6/6	6
15	Level of Education	1	1	1	1	1	1	1	1	1	1	6/6	6
16	Face to Face/Online	1	1	1	1	1	1	1	1	1	1	6/6	6
Total												90	
												0.9	
												90%	

Table 3 Feedback for the KSGDM model

No.	Element	Description
1	Content	Content used for game-based application should be extracted from the book issued by the authority.
2	Pronunciation	Pronunciation helps to understand the vocal sound of the word, which is an important element in the game.
3	Assessment	The assessment may be evaluated in difficulty level forms (easy, medium, and advanced).
4	Achievement	Achievements build the passion in the student to learn more.
5	Reinforcement	It enforces the student to recall the topic where mistakes were made.
6	Ranks	Ranks decide the students' achievement.
7	Usability Guidelines	By following the usability guidelines, the game-based application will be robust.
8	Usability Testing	Game-based applications may be evaluated with proposed heuristics from teachers/experts and the students.

Android platform (Unity). The game prototype was evaluated in two stages before actual human interactive experimentation. In terms of the contents, LLG consists of eight modules; “Sound,” “Singular/Plural,” “Uses (is/am/are),” “Action Words,” “Parts of Speech,” “Sentences,” “W Family,” and “Comprehension.” All the ingredients in the aforementioned different heads were tailored according to the needs of Pakistani culture. Based on the guiding principles of the proposed framework, it was deemed necessary to consider localized content, color scheme, and images while developing the game. The cultural context game has icons, pictures, pronunciations, and accents according to the localized setting of a culture. The low-fidelity and high-fidelity prototypes of the game are presented in the following sections.

4.1 Low-Fidelity prototype of LLG

In this section, the low fidelity prototypes of LLG were developed and presented based on the theoretical model shown in Fig. 1. The goal of the game was to learn the English language in the cultural context of Pakistan. As a student launch the game, it takes to the main screen containing all the modules given in the figures below. In the first Sounds module, a student can see the ‘vowels,’ ‘short vowels,’ and ‘long vowels’ modules along with the assessment. By clicking on any icon, it takes to the learning screen of the respective module. Importantly, when students click on the desired module’s assessment, a screen containing ‘Easy,’ ‘Medium,’ and ‘Advanced’ module, presented, which could be chosen based on the desired complexity. The screen of ‘Medium’ and ‘Advanced’ assessment modules contains the ‘Hint’ option, which a student can use to get help from the learning screen to solve the question. If a student makes three mistakes, it will show a message to recall the learning topic, and lastly, a result screen with the reward can be seen after solving the exercise. Figure 2(a–f) shows the partially low-fidelity prototype of the main screen, sounds, parts of speech, and assessment modules.

4.2 High-fidelity prototype of LLG

This section presented the high-fidelity prototypes of LLG. The goal for developing the high-fidelity prototypes was to add interactivity, sounds, and pronunciation of words for the ease of students to learn the English language in a cultural context. As the student launch the game, it takes to the main screen containing all the colorful icons of the topic, i.e., Sounds, Singular/Plural, Uses, Action Words, Parts of Speech, Sentences, W Family, and Comprehension. Each module in the game contains learning and assessment screens, and the assessment screen further includes ‘Easy,’ ‘Medium,’ and ‘Advanced’ complexity for the students. The screen of the ‘Medium’ and ‘Advanced’ assessment modules contains the ‘Hint’ option, which helps the student solve the question by revisiting the topic from the learning screen. If a student makes three mistakes, it will show an instruction to recall the learning topic again. Lastly, a result screen with the reward can be seen after solving the exercise that shows the correct and wrong attempts during the examination. Figure 3(a–i) presents the high-fidelity prototypes of LLG.

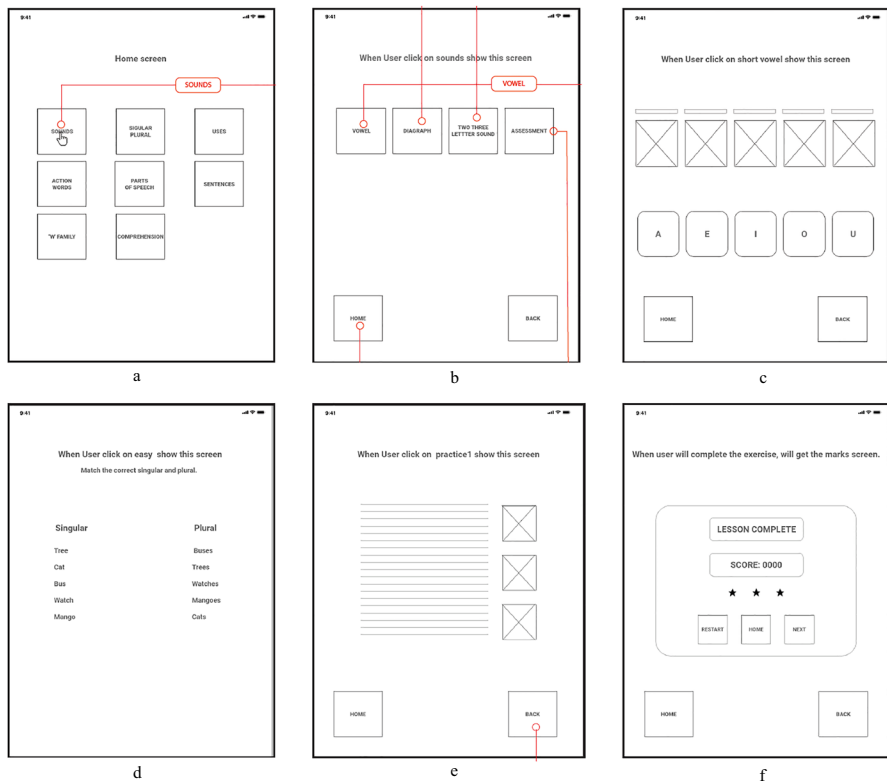


Fig. 2 Low-fidelity prototype of LLG. **a** Low fidelity-1. **b** Low fidelity-2. **c** Low fidelity-3. **d** Low fidelity-4. **e** Low fidelity-5. **f** Low fidelity-6

4.3 Usability testing method for LLG

This research implemented heuristic assessments and the think-aloud approach to evaluate and identify deficiencies with the LLG Graphical User Interface (GUI) that were not suitable for language learners. As a result, designers were able to create a better product, whereas usability experts were able to identify potential challenges with the design. The usability was measured at two stages: 1) low-fidelity prototype and 2) high-fidelity prototype. A questionnaire was administered involving a heuristic developed by the researcher for language learning games in a cultural context, as it was not previously focused on by the researchers (Hermawati & Lawson, 2016; Quiñones & Rusu, 2017). Nielsen (1994a) estimated that five and eight evaluators were needed to complete a heuristic evaluation. In this study, teachers and a game developer were the evaluators for low-fidelity prototypes. In contrast, teachers and students were involved in assessing high-fidelity prototypes of the game. Moreover, teachers also participated in the think-aloud method for evaluating the usability of high-fidelity prototypes. Teachers were chosen as evaluators because they had an

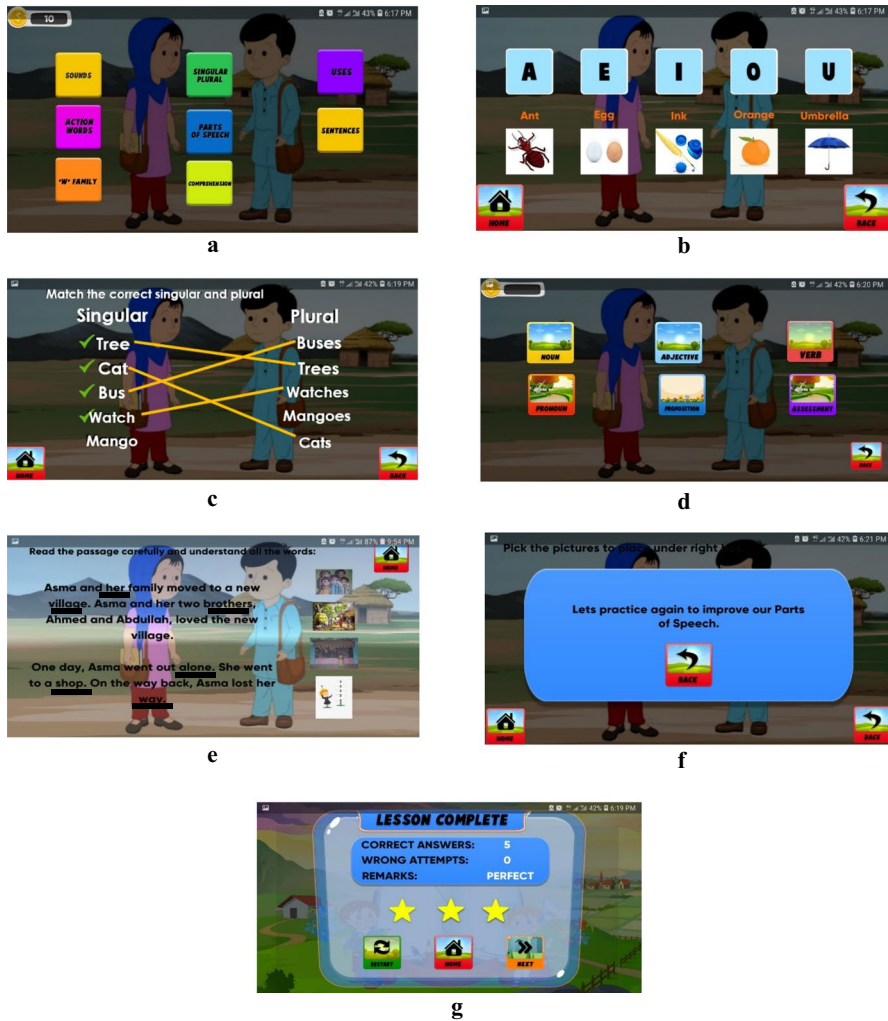


Fig. 3 High-fidelity prototype of LLG. **a** Main Menu screen. **b** Learning Vowels. **c** Singular/Plural Assessment. **d** Parts of Speech. **e** Learning Comprehension. **f** Instruction after mistakes. **g** Result screen

excellent awareness of the assessment for the game content, and the developer had a great understanding of the capacity to identify the proper game aspects.

The heuristic evaluation was performed in two sections: Low-fidelity prototype evaluation of paper-based game was performed by teachers and game developer in the office of senior headmistress (Sr. HM). Whereas, High-fidelity prototype evaluation was performed by teachers in the office of Sr. HM and students in their classroom. The next step was the think-aloud method, in which evaluators shared their views about the game and the researcher recorded all the points on paper and a tape recorder. After the evaluation was complete, the data was analyzed right away. The researcher translated the transcripts

from the Urdu language to English to perform the analysis. A triangulating approach was used to assess accuracy in data transcription by an evaluator and a co-researcher. This approach was used to improve the reliability and trustworthiness of findings in which data was collected in various methods and outcomes were assessed separately, but they had to be compared to one another (Denzin, 1994). The findings were subsequently incorporated into the participant's survey responses and observations by the researchers.

4.4 Result of low and high-fidelity prototype

The outcomes of the experts' heuristic assessment and think-aloud approach were discussed in this section. According to Nielsen (1994b); Nielsen and Loranger (2006), the outcome of a heuristic assessment is a summary or a tabular form of usability concerns. The results were compiled through descriptive analysis using Microsoft Excel. Each expert indicated 'Yes,' 'No,' or 'Not sure' in reply to the low and high-fidelity LLG prototypes. The majority of heuristic assessment items received 100% on average, while a few items received 80% for assessing a low-fidelity prototype. Overall, the heuristic evaluation and think-aloud approach demonstrated that the low-fidelity prototype incorporated most of the needed cultural context, educational, and language learning features. As a result, the prototype was easy to use.

In a similar way, a high-fidelity prototype was validated by five experts and twenty students using LLG on tablets and smartphones. The response was recorded with 'Yes,' 'No,' or 'Not sure' on the questionnaire sheet of proposed heuristics. The phrase 'Not sure' indicated the probability that the expert was uncertain about the response to the issue. The majority of heuristic assessment components received an average score of 100%, but one element received an average score of 80% from teacher experts, whereas five elements received an average score of 90% with the phrase 'not sure' from student assessors. Overall, the heuristic evaluation and think-aloud technique produced extremely good findings, showing that the high-fidelity prototype included the majority of the needed cultural context, educational, and language learning features. All of the objects included in the heuristic's sections were considered necessary by the instructor and student assessors.

5 Experiment and evaluation results

5.1 Experimental setup

This section presented the methodology for the study, including design, population sample, and the experimental procedure.

Quasi-experimental design This quantitative research study was conducted through a quasi-experiment. Three groups were formed (traditional group, experimental serious game group, experimental LND¹ group) to carry out pre-test and post-test. The

¹ Literacy and Numeracy Drive: a simple mobile application adopted in Government schools of Punjab Province, Pakistan to teach student's English language.

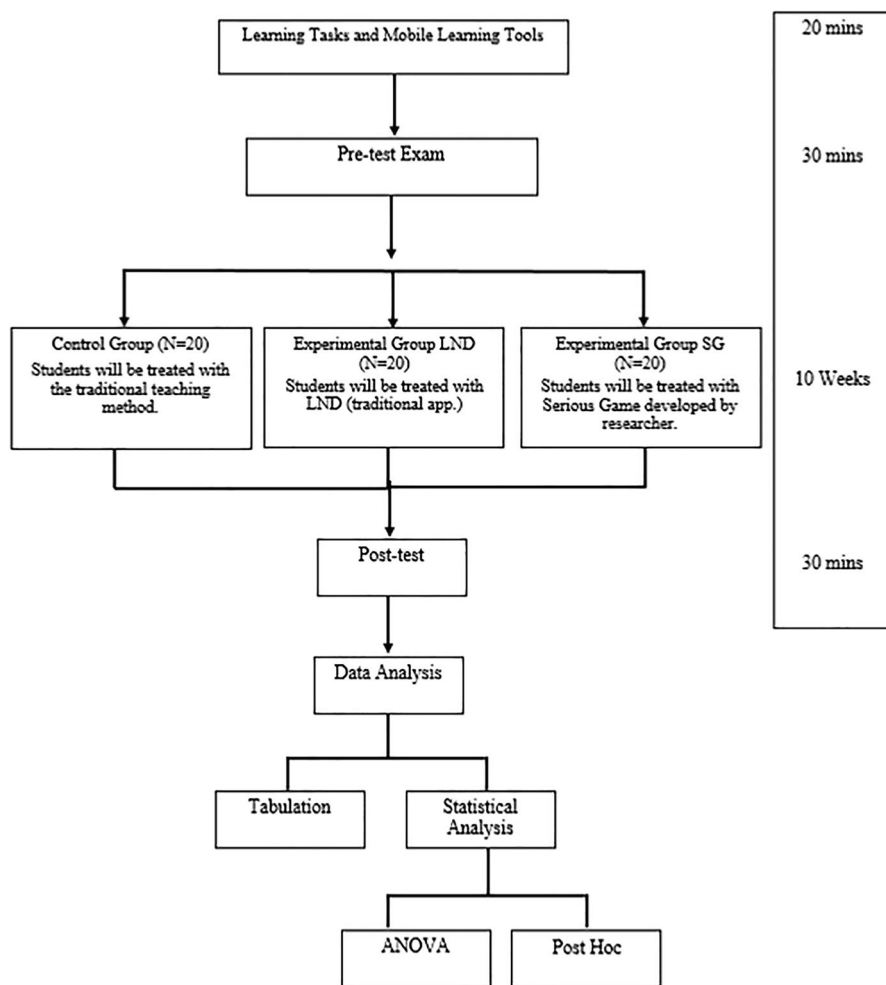


Fig. 4 Experimental Procedure

experiment was conducted in three stages: 1) For the pre-test, a question paper consisting of four questions (10 marks each), prepared by the Sr. HM., was given to all the groups for 30 min. 2) The treatment was given only to the experimental serious game group for ten weeks, and the rest of the groups were treated as per their routine. 3) Post-test was conducted on all the groups for 30 min by giving another question paper to get the results after the treatment. Figure 4 illustrates the detailed experiment procedure performed in this study.

Instrument Two question papers (one for pre-test and one for post-test) were designed by the school senior subject experts to evaluate the students in pre-test and

post-test, separately. The post-test question paper was a bit more difficult than the pre-test. All the students of the three groups had to solve the same question paper to evaluate the performance level involving major topics (reading, vocabulary, pronunciation, comprehension).

Population sample This study selected sixty students randomly from grade three of Government Girls High School. The average age of the students was eleven years. There were three groups, and each group consisted of 20 students, and the test was conducted in separate rooms. Three teachers separately invigilated the class, whereas Sr. HM supervised the examination. The researcher was present there to observe the whole process.

Pre-test The data were gathered at the start of the winter session in 2020 for pre-test, whereas the exam was conducted for all the groups in English class. After completing the exam, the concerned teachers collected the answer sheets and prepared the result. In the end, the result sheets were counter-signed by Sr. HM and handed over to the researcher.

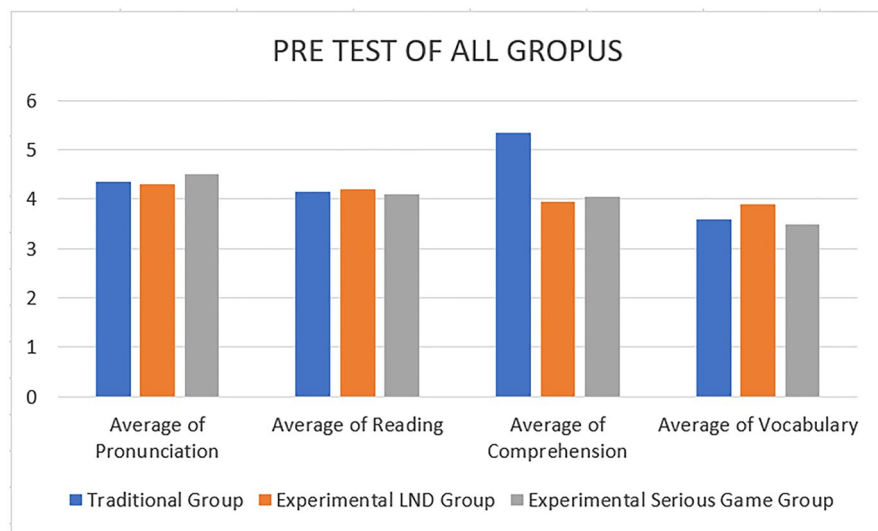
Treatment This section described the treatment procedure given to all the groups that participated in the experiment. All the groups followed the treatment separately through their respective method, and the groups had to cover up a similar syllabus for ten weeks. Sr. HM supervised the whole process being conducted on all the groups. The researcher guided the teachers and students on their issues during the learning and assessment process. Group-wise treatment description was mentioned below:

- 1) *Traditional group*: This group did not receive the experimental treatment, whereas they were taught the conventional method without using technology.
- 2) *Experimental LND group*: This group received the treatment through the current practicing LND application. They were taught through the syllabus book and the practice on the tablets by the teacher.
- 3) *Experimental serious game group*: This group received the treatment of LLG developed by the researcher. Before starting the treatment, students were given a brief overview of the designed game for language learning and how to use it properly to get effective learning outcomes. Students enjoyed performing on the game's new features, i.e., color scheme, interactive interface, sound effects, and pictorial presentation of the content.

Post-test All three groups of twenty students were aligned according to their sitting plan in different rooms in the post-test. Students had to solve another question paper because the experimental serious game group was only treated with LLG, whereas other groups were treated with the traditional methods. The question paper was a bit more difficult than the pre-test, but the nature of the questions was the same as the pre-test. The researcher observed all the activities and guided the teachers and students where necessary. The post-test data was gathered at the end of the winter

Table 4 Pre-test result of all the groups

	Traditional Group	Experimental LND Group	Experimental Serious Game Group
Average of Pronunciation	4.35	4.3	4.5
Average of Reading	4.15	4.2	4.1
Average of Comprehension	5.35	3.95	4.05
Average of Vocabulary	3.6	3.9	3.5

**Fig. 5** Bar chart of all Pre-test group

session in 2020, and the exam was conducted during the English class. The teachers collected the answer sheets and prepared the result. In the end, the result sheets were counter-signed by Sr. HM and handed over to the researcher.

5.2 Results and discussions

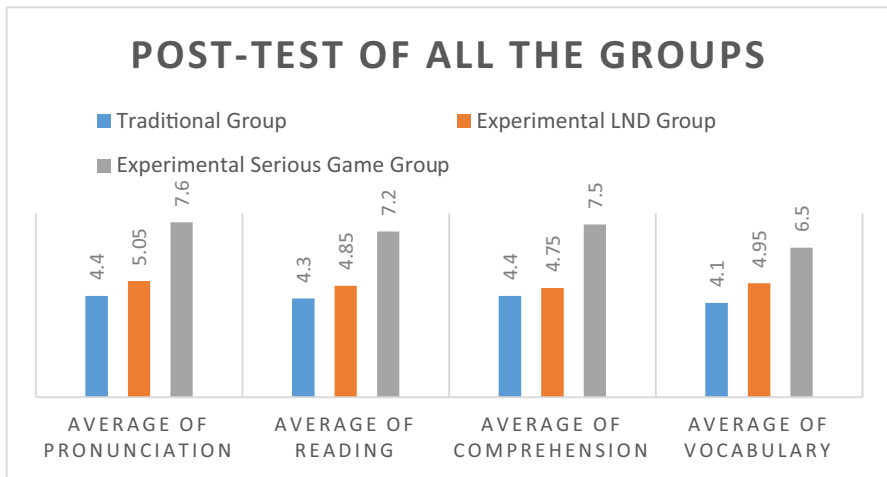
This section presented the results of all the groups in two ways: 1) tabular form (average marks) 2) statistical analysis.

5.2.1 Tabulation

Pre-test results Table 4 presents the average results of all the groups for pronunciation, reading, comprehension, and vocabulary. The groups showed similar results in all the topics, whereas the traditional group showed 5.35, the highest marks in comprehension only. Figure 5 shows the graphical representation of the pre-test results of all the groups.

Table 5 Post-test result of all the groups

	Traditional Group	Experimental LND Group	Experimental Serious Game Group
Average of Pronunciation	4.4	5.05	7.6
Average of Reading	4.3	4.85	7.2
Average of Comprehension	4.4	4.75	7.5
Average of Vocabulary	4.1	4.95	6.5

**Fig. 6** Bar chart of all Post-test group

Post-test results Table 5 presents the average results of all the groups for pronunciation, reading, comprehension, and vocabulary. The groups showed similar results approximately in traditional and experimental LND groups, whereas a significant improvement can be observed in all the experimental serious game group topics. Figure 6 shows the graphical representation of the post-test results of all the groups.

Statistical analysis is a procedure that allows you to make quantified conclusions about a process or a set of processes using data (*Statistical tests*, n.d.). In analyzing differences in scores for two or more groups, statistical tests, i.e., t-test and ANOVA, may be employed. In this section, a statistical test Analysis of variance (ANOVA) was applied to identify the significant difference between the means of more than two groups. The ANOVA test only shows the significant difference among the different groups but does not indicate the specific group. Therefore, TukeyHSD (Tukey's Honestly-Significant Difference) Post Hoc test was suitable for finding the difference of a particular group among the various groups (Ishaq et al., 2021a).

Table 6 Descriptive of ANOVA

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.	
					Lower Bound	Upper Bound			
Pre-test_T_LND_SG	Traditional_Group	20	17.4500	3.73427	.83501	15.7023	19.1977	12.00	25.00
	LND	20	16.1500	2.73909	.61248	14.8681	17.4319	9.00	21.00
	Serious_Game	20	16.3500	2.20705	.49351	15.3171	17.3829	13.00	20.00
	Total	60	16.6500	2.96776	.38314	15.8833	17.4167	9.00	25.00
Post-test_T_LND_SG	Traditional_Group	20	17.2000	2.87640	.64318	15.8538	18.5462	12.00	22.00
	LND	20	19.6000	1.14248	.25547	19.0653	20.1347	18.00	22.00
	Serious_Game	20	28.8000	1.47256	.32927	28.1108	29.4892	27.00	33.00
	Total	60	21.8667	5.40391	.69764	20.4707	23.2626	12.00	33.00

Table 7 ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Pre-test_T_ LND_SG	Between Groups	19.600	2	9.800	1.117	.334
	Within Groups	500.050	57	8.773		
	Total	519.650	59			
Post-test_T_ LND_SG	Between Groups	1499.733	2	749.867	191.498	.000
	Within Groups	223.200	57	3.916		
	Total	1722.933	59			

5.2.2 Statistical analysis

ANOVA Table 6 presents the pre-test and post-test variance of all the groups (Traditional, Experimental LND, and Experimental Serious game).

Table 6 presents the descriptive results of the pre-test and post-test groups in which twenty students participated each group. The mean and standard deviation of each group was also shown where the traditional group had 17.45, the experimental serious game group had 16.35, and the experimental group LND had 16.15 mean. In the post-test, the mean of the experimental serious game group was higher than the traditional and experimental group LND which was 28.80.

The ANOVA results in Table 7 revealed the significant difference between groups as demonstrated by ANOVA ($F(2.57) = 191.498$, $p = .000$). Table 8 showed the Tukey post hoc test multiple comparisons of groups revealed significant pairwise differences between experimental serious game group, experimental LND, and traditional group in post-test, but there was no significant difference between the groups in a pre-test. The pairwise difference between the experimental serious game group and the traditional group was 11.6 ($p < 0.05$), whereas the difference between the experimental serious game group and experimental LND was 9.2 ($p < 0.05$). The p value of 0.00 was less than the standard .05 alpha level.

6 Conclusion

This study presents the findings of a longitudinal study that commences with proposing a new model (KSGDM) for designing and developing a serious game for language learning in a cultural context. The proposed model unites the sociocultural theory with the concepts and elements of the serious game while considering the requirements and educational settings aim the effectiveness and usability of the developed game. Subsequently, the Language Learning Game (LLG) was designed and developed based on the KSGDM model. The requirements to develop this game were gathered through the literature review and a preliminary survey. Findings from the literature review identified the need for such a model to focus on cultural context

Table 8 Multiple Comparisons (Tukey HSD)

Dependent Variable	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Pre-test_T_LND_SG	Traditional_Group	Serious_Game	1.10000	.93663	.473	-1.1539	3.3539
		LND	1.30000	.93663	.354	-.9539	3.5539
	LND	Traditional_Group	-1.30000	.93663	.354	-3.5539	.9539
		Serious_Game	-.20000	.93663	.975	-2.4539	2.0539
	Serious_Game	Traditional_Group	-1.10000	.93663	.473	-3.3539	1.1539
Post-test_T_LND_SG	Traditional_Group	LND	.20000	.93663	.975	-2.0539	2.4539
		Serious_Game	-11.60000*	.62576	.000	-13.1058	-10.0942
	LND	Traditional_Group	-2.40000*	.62576	.001	-3.9058	-.8942
		Serious_Game	2.40000*	.62576	.001	.8942	3.9058
	Serious_Game	Traditional_Group	-9.20000*	.62576	.000	-10.7058	-7.6942
			11.60000*	.62576	.000	10.0942	13.1058
		LND	9.20000*	.62576	.000	7.6942	10.7058

*. The mean difference is significant at the 0.05 level

by incorporating serious game. The low-fidelity and high-fidelity prototypes of the game were refined and validated using appropriate methods and heuristics proposed by the author in the previous study. Furthermore, a quasi-experimental approach was used to evaluate the effectiveness of the LLG by involving the teachers and students of public sector school. After the endorsement, the results were delivered to the researcher, and data were analyzed in two forms (tabulation and statistical analysis) to measure the effectiveness between the control group, experimental LND group, and experimental serious game group. In the pre-test, the tabulation data in the result section revealed no significant difference between all the groups, whereas, in the post-test, there was a significant improvement in the experimental serious game group over other groups. Thus, the proposed game-based model is significantly better than the existing methods.

7 Limitation of the study

The importance of a serious game design model concerning language learning in a cultural context has been explored in this study. Although this study aimed to shed light on several relevant aspects of the fields, it has several limitations. The main limitations are: this study focused on English comprehension in language learning in public sector schools of district Sheikhpura and the culture of Pakistan. The students from grade three were selected to experiment with the game developed by the researcher because the current practicing application for language learning was already implemented in schools to learn English. Moreover, the usability of the high-fidelity prototype was evaluated from twenty students of grade three, whereas it can be measured from other class students of the schools.

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Data availability Not Applicable.

Code availability Not Applicable.

Declarations

Competing interests The authors have no conflicts of interest to declare that are relevant to the content of this article.

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