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Mohsen Keshavarz, Leili Mosalanejad

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Implementation of educational gamification in blended learning environment: experiments of field from multi-trial in medical sciences groups

Mohsen Keshavarz

Department of E-Learning in Medical Sciences,
School of Paramedical Sciences,
Torbat Heydariyeh University of Medical Sciences,
Torbat Heydariyeh, Iran
Email: keshavarz_mohsen@yahoo.com

Leili Mosalanejad*

Department of Medical Education,
Virtual Center,
Jahrom University of Medical Sciences,
Jahrom, Iran
Email: mosallanejad@jums.ac.ir
*Corresponding author

Abstract: Using educational games is one of the fun and effective teaching methods. The purpose of this research is to design and implement an educational gamification program in the form of blended learning models and also, evaluate it in students' learning environments and accept it from students' points of view in multi-trial groups. This research is semi-experimental in multiple groups and disciplines. The educational game was designed with the topic of addiction and was implemented in the form of blended learning models, in three groups for four years between 2019–2022. The results showed that after educational intervention, the mean score of most of the items was higher than the total average. In addition, studying and understanding concepts, supporting students in exams, creating motivation in learning, and success in lessons had the greatest impact on students' learning. The results of game acceptance in educational games were higher than average in all dimensions.

Keywords: active learning; game-based learning; medical science education; blended learning.

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Biographical notes: Mohsen Keshavarz holds a PhD in Virtual Education Planning. He is a faculty member and the Director of the Virtual Education Center of Torbat Heydariyeh University of Medical Sciences. His research interests include online and virtual learning, blended learning, telemedicine, new educational technologies, e-health, and multiple literacies in online environments. He is an energetic advocate of distance learning in his home country of Iran, having translated Tony Bates's book *Teaching in a Digital Age*

to Persian in addition to several other projects, some with international collaborators. He has recently been introduced by Leaders & Legends of Online Learning as an international figure in the field of online learning.

Leili Mosalanejad is a Professor of Curriculum Planning at the Department of Medical Education, Virtual Center, Jahrom University of Medical Sciences, Jahrom, Iran. Her research interests include online and virtual learning, blended learning, mobile learning, new educational technologies, e-professionalism in medical sciences, gamification in online environments, and gamified web-based education. She has published many articles in reputable international journals.

1 Introduction

Today, one of the main characteristics of learners in the digital age is having the skills needed to teach and learn new digital environments. For this reason, teachers must be proficient in new technology methods so that they can use new teaching methods in the digital world and make the learning environment and classroom more effective. (Keshavarz and Ghoneim, 2021).

For international education to effectively move toward a hybrid model of online and physical campuses and flexible learning programs, it is not only educational approaches that must be considered, but also financial, technical, and educational solutions that must be considered. They provide high-quality, flexible learning solutions. Online learning returns to education delivered over the internet and include a wide range of online applications to access educational materials, also to facilitate teacher-student interaction. Online learning is a term that is often equivalent to distance learning and e-learning (Keshavarz et al., 2022). E-learning encourages and supports active learning regardless of time and place using specific principles and tools such as web-based communication, participation, knowledge transfer, and multimedia. These changes are considered key innovations in education (Mirmoghtadaie et al., 2023).

In the past few years, one technological trend that has been heavily focused on by researchers in many fields, including education, is gamification. The use of gamification in education utilises gaming elements and aesthetics to enhance students' motivation and promote learning (Zimmerling et al., 2019).

Provisioning of health services will be possible when graduates can adapt themselves to the increasing expansion of medical knowledge, complexities of the clinical environment, rapid changes in technology, and its impact on the scientific needs of society. Increasing potential in the volume of information is considered a major educational problem; As a result of this explosion of information, the highest percentage goals of each educational course are concentrated in the field of knowledge (Mehdian et al., 2002). Medical science education is associated with the complexities of the theoretical and clinical learning environment. Therefore, to achieve successful and efficient training as well as dynamic quantitative and qualitative development of medical sciences, it is necessary to provide the basis for improving educational productivity with effective planning (Kuper and D'Eon, 2011).

Results of the conducted research indicate the existence of ambiguity in the role of trainers and lecturers, the role of students, and the inappropriateness of educational

situations. Also, there is an educational gap between clinical situation and theoretical principles, which will affect the quality and desirability of educational services (Croxon and Maginnis, 2009; Fulmer et al., 2011; Mehrdad et al., 2008; Pérez Rivas et al., 2012; Winter et al., 2016). Results obtained from the study of developing the higher education system in the last two decades in terms of student population indicate small growth in education, insufficient attention to the educational quality of universities, and efforts to improve it. Meanwhile, due to the increasing level of awareness in society, the level of people's expectations from medical staff has increased (Turney, 2007). One of the methods that emphasise its use in various subjects is the game. Regardless of the audience and topic of education, using games in education can help teachers design their educational topics more exciting, informative, and fun (Bagheri and Talimi, 2021; Sabri et al., 2022). Game-based learning is defined as using games or simulations in any form to achieve specific learning goals. Along with the advancement of technology, the combination of game-based learning facilities has been investigated in different ways. Shifting towards game-based learning is largely due to the engaging nature of games. Although there is still no significant empirical evidence for the effects of game-based learning, there is evidence that shows using games can potentially improve the level of student learning. However, many educational games have created questions and exercises in game format with little thought for game mechanisms and how to increase student learning (Zhang et al., 2020). Educational games are usually used to help students deal with challenges that they face in the learning process. Games are useful educational tools that enable people to learn knowledge in a fun and challenging environment (Russell, 1999; Şen, 2020). The use of educational games and games is one of the fun and effective teaching methods that can be used as one of the teaching methods in the current era of education (Kerby et al., 2011). The main goal of the study was the implementation of educational gamification in a blended learning environment to conclude the impact of the intervention on two dimensions of students (learning as a knowledge dimension and game acceptance as an attitude towards the game).

2 Literature review

2.1 *Define of gamification*

Gaming has entered the human world in the past decades and is used in various fields, including education. According to Kappa, gamification is the use of game design elements, game mechanisms, aesthetics, and game thinking for non-game applications and creating motivation in learners. Although there is no universal term for game development, most of the terms have a series of described and standard features. However, recently, gamification has focused on digitising learners' activities and using applications and platforms using digital devices such as tablets, smartphones, and computers (Kalogiannakis et al., 2022).

There are different types of games, in a serious game, the educational goals are often not known to the players, the environment does not necessarily represent reality, and its main focus is to motivate the student to 'play' the game without having a limit in the number of game mechanics. In other ways, in a gamified application, all learning goals are always visible and known to the users from the get-go (Hu, 2020).

According to Lander, the most obvious difference between serious games and gamification is in teaching the learning process. In serious games, because learning is directly affected, the educational content in the program causes learning. However, in gamification, learning is mostly achieved indirectly, as the goal of gamification is to change the learner's behaviour or attitude towards the text (Landers, 2014).

2.2 Game-mechanics

Game components are the main parts of gamification that generally represent functional elements that can be found in games such as storytelling, badges, and avatars. Gamification is distinguished by the integration of game-related design elements or activity formats into an educational context, either digitally or non-digitally (Buckley and Doyle, 2016).

Using games in the educational environment is not a new thing. However, the concept and implementation of gamification in the educational sector have been raised in recent years. Several researchers in gamification have shown that many contextual factors, including the content of the gamified activity and its target population, influence its use in education (Orhan Göksün and Gürsoy, 2019).

2.3 Theories underpinning gamification

The main reason for using gamified programs has been their theoretical ability to increase the motivational power of games. As a result, in terms of theories related to gamification, the most common theory related to the basic goal of gamification, i.e. motivation, is self-determination theory. Other theories like Bandura's self-regulated theory or the goal setting theory take into account a part of motivational aspects (Richter et al., 2015).

2.4 Self-determination theory

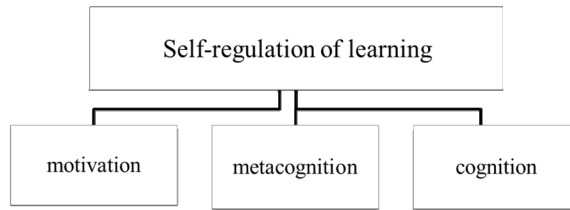
SDT is a macro-theory of human motivation and personality that suggests that humans have an innate psychological need for autonomy, competence, and connection (Ryan and Deci, 2017). According to the SDT, when needs are met, individuals are more likely to act autonomously and self-regulated, leading to more positive outcomes. On the other hand, when these needs are thwarted, individuals are more likely to engage in controlled and reactive behaviours, leading to negative consequences.

2.5 Self-regulated learning

According to Bandura (1988), self-regulation is defined as psychological efforts to control internal situations, processes, and functions to achieve higher goals. Self-regulated learning not only enhances students' learning, but also provides opportunities for them to actively manage processes such as goal setting, self-control, self-evaluation, and self-motivation (Figure 1). Students who use more self-regulatory strategies (by striving for success, enjoying challenges of activities, using learning strategies appropriately, setting specific goals, and showing a high level of self-efficacy) achieve significant academic progress. While a students who use these strategies less, their learning is parrot-like and is done only by repetition (Konti, 2011; Bailey and

Heritage 2018). The motivation and self-control of the learners, the more helpful it will be in the implementation of educational games to advance the learning goals.

Figure 1 Self-regulated learning includes three main components: cognition, metacognition and motivation



2.6 Educational games in teaching and learning

Educational games are divided into 4 groups: simulation – game-making – cooperative games – and playing in a real environment (Akl et al., 2010). Gamification means applying principles of game design and its indicators in non-game applications. Gamification is an alternative approach to traditional e-learning that enables learners to experience comprehensive and effective learning experiences. In fact, in this method, learners can be trained and encouraged to apply this type of learning by using game principles and innovative elements and strategies. Gamification prepares an effective informal learning environment and helps learners practice real-life situations and learn with these challenges in a safe environment. Being story, having rules, having control, the possibility of exploration, interacting with the audience, giving feedback, time limit, having stages, getting rewards, the possibility of competing with others, etc. (Sandrone and Carlson, 2021). Several studies have shown that games are effective in the learning process. Educators agree that games have positive effects on achievements, problem-solving, perception, creativity, reasoning, interest, and interaction in learning. Games are useful in developing the mind and speeding up the learning process, contributing to an informal environment in the classroom by promoting more interaction between peers and learning motivation. Also, by participating in games, students process information better and learn and understand concepts much more easily (Júnior et al., 2019).

The advantages of using games in education are:

- increasing the level of communication between learners and educational content
- increasing fun and mutual interaction during the e-learning process
- improving absorption and storage of the information
- providing opportunities to observe and apply learning in real-world
- improving overall learning experience for all ages (Domínguez et al., 2013).

Learning through games has many advantages. One of the most important advantages is the inherent reward of this method because this method increases the durability of learning simply and understandably (Safavi, 2000). Some experts also believe that educational game is compatible with Kolb's learning cycle and can be an effective

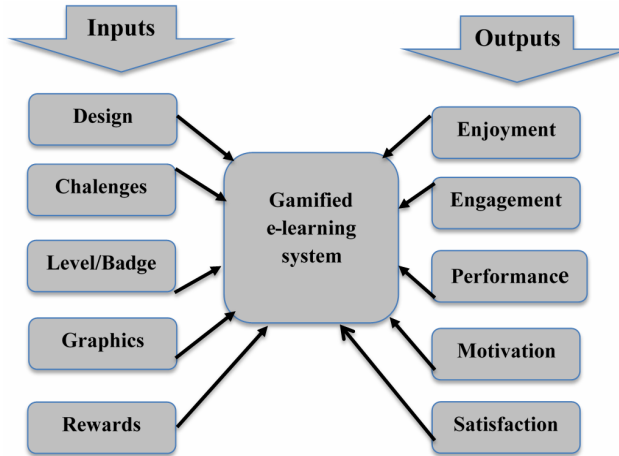
method of transferring learning experiences in a learning cycle with four phases including objective experience – reflective observation – abstract conceptualisation and active experimentation. It should be noted that game with their special conditions provides the possibility of creating an active experience in this learning cycle (Hinojosa, 2015). Game-assisted teaching strategies can be used in large and small learning groups, along with teaching methods such as lectures, seminars, bedside teaching, and e-learning. Using this method in the teaching of medical sciences is associated with many advantages, among which we can mention active stimulation of learning and improvement of student understanding. Also, this method provides the possibility of more interaction and participation of students and enjoyment from class.

It should be noted that using photos, sound, and animation in education creates more variety and will increase student participation in learning. Experts believe that one of the reasons for the success of the game method compared to other teaching methods is the creation of reflective and collaborative participation for learning (Englert, 2010; Hazavehei et al., 2007). Learning through games has an intrinsic reward and most games display complex life situations, concepts of which are derived from real life in a simple and comprehensible way (Hazavehei et al., 2007). Some elements of games that can motivate students and facilitate learning are advanced mechanisms (points/signs/leaderboards), story and characters, player control, immediate feedback, creating opportunities for cooperative problem solving, distributed learning with increasing challenges, providing the right situation to master learning and increase social communication. The new technology of gamification with understanding detailed goals, and perspectives, with the help of game elements and techniques, promotes motivation, participation, and change in learners and ultimately changes in the outcome of their behaviour (Zabala-Vargas et al., 2021; Krath et al., 2021). Teaching and learning, like any other process, are the active process that needs motivation in its various stages to start and last. In today's era, one of the syndromes of learning environments is the problem of lack of motivation or its lack in different educational levels. Boring educational environments lead learners from creativity and flourishing to repetition and unconditional acceptance (Sandrone and Carlson, 2021). Therefore, considering the many advantages that gamification has had for learners and the role that it plays in increasing the enjoyment and effectiveness of the learning process, it has become a popular approach in the education process. It is an undeniable fact that successfully of gamification in the teaching and learning process is due to the existence of completely scientific principles (Hassan et al., 2021). One of the technology-based methods is using blended learning models. Games can be used in this model and can be used through integration with face-to-face training and in the form of range in blended learning models. Active strategies of teaching and learning in students and improving their knowledge, attitude about addiction, and prevention of addiction are very important. Considering that this group of students are community health staff and their services are provided directly to the community, the researchers decided to design a new lesson unit by creating new methods and using educational games. This method can play an effective role in improving learning and the quality of education. In this study, gamification was used in the form of mixed-learning models to teach students. In designing educational games, the main elements and components should be considered. The dominant model in this research was gamified e-learning system proposition model (Klock et al., 2015).

2.7 Proposed design for the hybrid model in gamification

In this study, gamification was used in the form of hybrid learning models to teach students, and the dominant model in this research was the blended model. Also, this study proposes a theoretical framework for applying gamification in e-learning environments to encourage learners to engage with the content and progress (Figure 2).

Figure 2 Gamified e-learning system proposition model (see online version for colours)



These steps are as follows:

- Defining the inputs as they are the characteristics because what makes an environment gamified are game elements which are the features that enhance the learning experience creating a ‘look and feel’ experience: badges, collaboration, feedback, freedom to fail, graphics leaderboard, levels, narratives, design (goals, rules, time limit, clues, competition), points, push notifications, tangible rewards, role play and competition.
- The e-learning system to gamify integrates all the characteristics mentioned in the previous paragraph and more if necessary to get an efficient application respecting gaming features.
- Have the outcomes and all the benefits expected as outputs of the model or design, especially:
 - 1 motivation: the willingness of someone to do something; drive and enthusiasm, so increasing motivation means increasing the desire to learn from the players
 - 2 satisfaction: the fulfilment and the exciting feeling derived during and after using games
 - 3 enjoyment: the pleasure and the fun having along with learning by the players
 - 4 engagement: the learner’s commitment
 - 5 performance: the increase of knowledge and acquisition efficiency (Sabri et al., 2022).

3 Material and methods

This study is a semi-experimental study to design, implement, and evaluate educational gamification in the form of blended learning models.

The learning objectives of each subject have been determined, ensuring adherence to the curriculum and desired results.

The goal of the study was to conclude the impact of the intervention on two dimensions of students (learning as a knowledge dimension and game acceptance as an attitude towards the game). The research questions are:

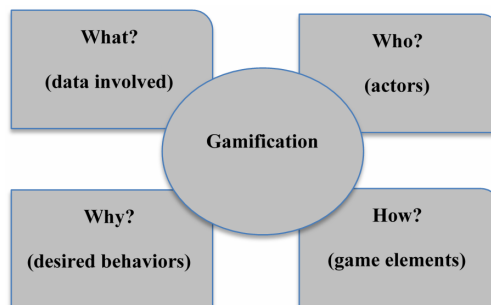
- Does educational gamification affect student learning in the blended learning environment?
- Does educational gamification affect game acceptance by students?

3.1 Design and setting

In the educational design of the process, a list of educational goals and needs of the groups in the field of substance abuse was compiled at the beginning. All groups have a lecture about this subject. Then, the expert team, accompanied by educational designers and technical designers of software programming, discussed and reviewed how to advance the program in several meetings.

The specialised team compiled the content based on the educational objectives and proposed its design narrative to the technical design team. The technical team, accompanied by experts, worked hard to investigate and implement the feasibility of the program, and after agreeing on all the gamification processes, started designing it based on the storyboard and expert suggestions.

Figure 3 Conceptual model of gamification e-learning based on students' learning (see online version for colours)



The next stage was the implementation of a pilot group of 10 students and checking possible bugs. After fixing the technical defects, the game was prepared for implementation.

In general, this study has tried the stages of game design adapted from the model of gamification e-learning based on students learning (Figure 3).

The conceptual model in Figure 3 achieved by Ana Carolina and used to implement a learning environment is constituted of four dimensions:

- Who: this dimension has to identify the main actors implied in the gamification process, for example: teachers or students.
- Why: This element defines the behaviours desired by the gamified system to enhance the student's interaction with the process.
- What: this aspect aims to define the data, the content, and the course.
- How: the how dimension serves to identify the game elements to use in the gamification process.

Based on the conceptual framework and the gamified e-learning system proposition model in the input section (design, challenges, level/badges, graphics, reward) we have to formulate learning majors for game design, according to the model of gamification e-learning based on students' learning we first identify inputs such as the main actors in the gamification process, the behaviours desired by the gamified system, content, and the course, and finally, identify the game elements to use in the gamification process.

In this section, the stages of game design included the following sections making games (using game elements in three parts of mechanisms, dynamics, and components, which includes dynamic design of items such as communication skills between parts, the possibility of upgrading to another level, and avatars).

Designing game mechanisms (creating challenges, feedback, access to resources and rewards, etc.).

And then, designing the main elements in the game (using avatars, models, contents, challenges, and conditions to reach higher levels of receiving gifts, leaderboards, obstacles, unpredicted situations, etc.)

3.2 *Game-making educational planning*

Educational planning was done with an emphasis on the most to learn, better to learn. For this purpose, capabilities of game design in educational design (use of sound and visual effects to engage senses, creative environment for competition and challenge, development of critical thinking) with the design of clinical cases (problem-based learning) and its affairs based on individual differences, practice, and repetition were used. The following items were considered in the educational design of the game:

- *Individualisation*: The level of the game is tailored based on the student's abilities
- *Feedback*: Immediate feedback is supplied during the game stages and levels
- *Active learning*: The game engages the player in an active process to increase their experiences and learning.
- *Motivation*: The players are engaged in self-promotion at each level of gamification
- *Social*: The players compare all learning with others.
- *Scaffolding*: Players are gradually challenged to develop their status, levels, and scores
- *Transfer*: The game fosters the ability of users to the real world and professional promotion

- *Assessment:* The player can assess the knowledge and abilities of peers on the board.

3.3 Software design and development

Game design was done based on two mobile platforms, android (on the IOS operating system) and network. This application was developed at the web address: <http://www.addiplay.ir> (Figure 4 to Figure 6).

Figure 4 Views the first page, the format of the question, and the end of the section by providing feedback and giving a medal to the user (see online version for colours)



Note: It should be mentioned that the presentation of game-making was done in the form of a combined educational program in the Persian language

Figure 5 Workbench and different sections of the test on the user page (see online version for colours)



Figure 6 Questions of different sections and how to provide feedback with different colours (see online version for colours)**Table 1** Gamification elements in application design

<i>Game mechanics</i>	<i>Dynamics</i>	<i>Game dynamic</i>
Scoring system	Challenges	Rewards
Ranking in leaderboard	Level of organisation main concept to complex	Achievement
Time pressure	Organisation of contents	Competitions
Avatar		Self-expression
Points		Rewards
Levels		Achievement
Badges		

3.4 Participants and sampling

Overall, 485 students in 3 groups participated in this study. Multidiscipline in different entering groups participated in this study. Public health (80 students), laboratory sciences (95 students), and medical (310 students) include studying for four years. Gamification is used for each group by blended models. All students used gamification from blended models and completed questionnaires after the intervention.

Blended learning models from self-blended and station rotation models are arranged in the teaching process. Blended learning allows students to fully focus on their studies. With the self-blended model, students can better understand how they learn best. The station rotation model allows students to move between stations on a fixed schedule, where at least one of the stations is an online learning station.

From the perspective of ethical considerations and people's satisfaction, it can be seen that the students were actively engaged in their work with appropriate legitimacy. This was reflected in their course plans and the perfectly oriented students. The grades awarded are also given as part of the overall students' scores. Analysis was anonymous in each group and each questionnaire was verified by cod number for analysis, also participants entered the program with consent, and assent was obtained before the start of the program.

All students were fully oriented about the training program and through the course design and were justified about the training and evaluation process. The training started with the lesson concepts and then one of the two models was implemented for each of the groups.

In the medical group, both models were used, and in the laboratory science and health group, the combined model was used. A part of the student's grade with marks out of 10 marks was allocated for playing gamification. This educational process was implemented in the form of a design/implementation program and evaluation of learning indicators among students, each step of which is described below.

3.5 Tools/instruments

3.5.1 Educational games acceptance

The questionnaire for acceptance in educational games consists of 21 questions, each of which has 3 questions. This questionnaire includes seven constructs: perception of ease of use, perceived usefulness, perceived pleasure, perceived control, concentration, attitude to use, and behavioural intention.

It is a 21-question questionnaire with a 5-point Likert scale from 5 = strongly agree to 1 = strongly disagree was used, in other words, a score greater than 3 meant accepting the desirability of the game components.

Validity of the questionnaire by content validity in a sample was the first part of using that. This questionnaire was translated, forward-backward translation, and content validity from the perspective of five students and ten educational experts in the field of e-learning, medical education, and educational management was examined. Also CVI or content validity index from ten educational experts was used. Experts were asked to determine the degree of relevance of each item in three areas of relevance, and simplicity. Validity index was (0.78). The reliability of the instrument was confirmed again with 30 samples by internal consistency analysis of questions with Cronbach's alpha 0.87.

3.5.2 Learning form of the blended learning environment

It is a 19-question questionnaire with four areas that were designed by Ballouk et al. (2022). This questionnaire includes areas of access and guides, class situation, presentation of materials, and internal-external motivation components, which respectively occupy 4, 5, 6, and 4 questions. Internal consistency and reliability tests were satisfactory (Cronbach's alpha ranged from 0.76 to 0.77). All stages of validity and reliability to the adapted questionnaire (cultural adaptation through forward/backward translation, face validity from audience and experts then finally reliability) were used. Internal consistency analysis of items collected with Cronbach's alpha 0.81.

4 Results

Overall 485 students in 3 groups participated in this study. 62.4% of students were female and the rest were male (Table 2).

Table 2 Demographic variables in participants

<i>Discipline blended models</i>	<i>Number of students</i>	<i>Course</i>	<i>Models</i>
Public health	80	Mental health and addiction	Self-blended
Laboratory	95	Psychology	Self-blended
Medical	310	Health psychology	Self-blended

The first part of the results presents student learning outcomes under the blended learning model.

Table 3 Student learning in the blended learning environment

	<i>Questionnaire</i>	<i>Mean</i>	<i>Std. deviation</i>
1	I search for resources to prepare learning content before active learning	3.8259	1.71596
2	Working in small groups increases the learning of concepts	3.1287	1.15611
3	Group activities enhance my learning	32.6832	1.67172
4	External audio-visual content has an important effect on my learning	3.7970	1.79922
5	The contents uploaded by the professor are important in learning concepts	3.0650	1.69563
6	Flexibility in adapting content is important to independent and active education	4.1450	1.57683
7	Studying concepts helps me in the exam	4.0941	1.91773
8	My motivation is effective in my learning and my success in the exam	4.0050	1.93037
9	Group discussions help stimulate learning	3.1990	1.78611
10	My learning habits are influenced by peers, discussions, and interactions with them	3.0198	1.70735
11	Learning objectives help organise and regulate learning	3.1287	1.81844
12	My learning is completed by maintaining and preserving findings through peers and professors	2.9851	1.79961
13	Access to resources enables independent learning	3.8069	1.70960
14	My training is complete with resources and access to various tools	3.4100	1.64482
15	Access to online and offline resources helps independent learning	3.9604	1.77837
16	I use the contents and lessons provided by the professor to learn more	3.7612	1.81458
17	Online resources are more effective because they are concise	2.7437	1.77230
18	Dedicated external resources can be effective in promoting independent learning	2.8663	1.85734
19	I integrate and use various existing and external resources to support learning	2.9403	1.92261

The results obtained from the present research showed that: in learning through games and blended learning models, flexibility in content adaptation is important in independent and active education.

Also, studying and understanding concepts, supporting students in exams, creating motivation in learning, and success in lessons had the greatest impact on students' learning.

The average of areas showed: that the average learning results in the blended learning environment are higher than the total average (Table 3).

Table 4 Mean of learning areas in the blended learning environment

	<i>Number of questions</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. deviation</i>
Resources (access, guidance)	4	4.00	28.00	21.61	5.89264
Cultural and social environment	5	5.00	35.00	24.0	4.00251
Content presentation	6	6.00	42.00	26.26	3.20062
Internal and external motivation	4	4.00	28.00	22.83	4.69769

Results of the effect of combined learning environment on students' learning rate showed that mean scores are higher than the average in all areas (Table 4).

The second part is the results of students' acceptance of the gamification.

Table 5 Results of game acceptance in educational games and its effect on students' learning rate

	<i>Questionnaire</i>	<i>Mean</i>	<i>SD. deviation</i>
1	It is easy for me to be a master in gaming	3.69	0.92
2	I think the game is easy	3.17	0.81
3	Learning to play is easy for me	4.04	0.83
4	I think this game is useful for me to better vocabulary learning	3.84	0.86
5	I think this game is useful for me to learn vocabulary in a fast way	3.93	1.0
6	I can achieve more effective learning through this game	3.98	1.0
7	I find the game exciting	3.59	0.94
8	I find the game enjoyable	3.57	1.14
9	I find the game interesting	3.68	1.16
10	I have full control over the game process	3.52	1.07
11	I don't feel confused while playing	3.526	0.98
12	I don't feel frustrated while playing	3.63	0.97
13	I'm stuck while playing	3.9342	1.03
14	I pay attention to the game when I am playing	3.98	0.82
15	I just focus on the game when I am playing	3.86	0.65
16	I think it's a good idea to play	3.96	0.843
17	I found that the game makes vocabulary learning more interesting	3.93	0.861
18	I would prefer to learn English vocabulary by using games	3.90	0.99
19	I would like to play this game again and again	3.63	1.04
20	I am willing to recommend it to another one, playing the game	3.50	1.19
21	I am willing to play the game again and again in the future	3.53	1.16

Another result states that students accepted the game and were satisfied to use it in the educational process. The mean score of most items was higher than average in the 5-score continuum (Table 5).

Table 6 The mean score of all dimensions in the game acceptance questionnaire

<i>Game acceptance areas Each dimension with 3 items</i>	<i>Mean</i>	<i>Std. deviation</i>
Understanding ease of use	10.85	1.65
Understanding usefulness	11.85	2.59
Understanding pleasure	10.28	3.75
Perceived control	10.71	2.19
concentrate	12.14	1.83
Attitude to using	11.92	2.33
Behavioural intention	10.35	3.41

Note: 21 questions

Table 6 showed that mean scores of usefulness, concentration, and attitude to using are higher than others. Results of the present study showed that among the fields of the questionnaire, level of concentration, attitude towards use, and understanding of usefulness have created the highest level of acceptance in the game. It should be noted that there was no significant difference between gender and level of satisfaction with the game

5 Discussion

Results obtained from this recent research showed that learning through games and combined learning models is important for flexibility in using content in independent and active education. Studying concepts, supporting students in the exam, creating motivation in learning, and success in the course were among the items that had the greatest impact on students' learning.

Numerous studies have shown that gamification can have effective educational and learning effects. The gamification can guide users through designated paths, give users immediate feedback, reinforce good performance, and allow users to pursue individual goals while showing goals and communication and choosing from different progress paths. Meanwhile, the system can adapt the complexity of the game to the user's abilities. Interactive and collaborative gaming elements can enable social comparison and connect users to support each other and work towards a common goal (Krath et al., 2021). Results showed that, among the fields of the questionnaire, level of concentration, attitude towards use, and understanding of usefulness, have created the highest level of acceptance in-game.

A study about strengthening motivation in mathematics courses and teaching processes in engineering, from game-based learning (to investigate the effect of game-mediated teaching strategies) on first-year engineering students was conducted. Results showed that the dropout rate decreased and enhanced educational processes in engineering. The motivation enhancement in this method in the current study had a higher average (Zabala-Vargas et al., 2021).

Game-based education in the course neurology and neuroscience: applications, challenges, and opportunities were conducted. The results of this study showed that using game-based learning may be an opportunity for effective use in learning neurology and neuroscience (Seaborn and Fels, 2015). Results of the present research also showed that supporting the learning of learners, in-depth learning of concepts and their usefulness is an advantage in using gamification.

Adaptive gamification in e-learning based on students' learning styles in another study showed that the motivation of learners increased by 25% in this method and the dropout rate decreased by 26% (Hassan et al., 2021). A study based on the performance of computer gaming on undergraduate students discussed stereochemistry through 230 new questions whose level of difficulty was specified in three levels. The results of this research showed that the feedback from students and professors who played the game was positive (Huang, 2019). In a study by Winter et al. (2016) about mobile games for organic chemistry students, most of the students improved their learning with this game. The effect of gamification on learning in students of different groups in the present study was positive.

Another study investigated comparing the level of satisfaction and level of learning by using traditional methods and educational games in teaching the subject of ectopic pregnancy. The results of this research showed that students were more interested in the educational game method than the traditional method. Also, student interaction, memorisation of course materials, and enjoyment of learning in this method are more than traditional methods (O'Leary et al., 2005). Results showed that among the fields of the questionnaire, level of concentration, attitude towards use, and understanding of usefulness, have had the highest level of acceptance in the game.

In the teaching of nutrition courses to students, the lecture method was compared with the role-playing method. Results showed that students' learning rate with the role-playing method was higher than with the lecture method (Hazavehei et al., 2007).

Many other studies have been conducted by emphasising the superiority of the game's method over than method of lecture. The results showed that this method has a greater effect on increasing students' learning than the reflective speech method (Akl et al., 2010; Steinman and Blastos, 2002; Huang, 2019; Winter et al., 2016). The effect of gamification in the form of blended learning models has not been investigated on performance in the present study. However, while accepting the game method, the students found this method effective in their learning. In a review of the role of educational games in increasing students' knowledge, the results of three studies showed that this educational method does not affect students' knowledge. This researcher suggests more studies with more reliable designs to confirm it. Using educational games in mental health courses showed that students' grades increased by 10% through using game strategies. This amount was 6 points higher than the control group (Bhoopathi et al., 2007).

Using games in education requires mental compatibility with the usefulness of this method in education. Among these cases, attention is paid to active learning as an educational experience that appears in the form of thinking at higher levels such as analysis, synthesis, and evaluation (Begg, 2008).

Results from a game in education in psychiatric courses showed that the indicators of self-regulation, self-centeredness (including self-control motivation), and self-management improved significantly after intervention. The intervention increased the average scores of students' self-regulation and self-management. In general, also it

can affect learning in a fun and interactive environment (Mosalanejad and Abdollahifard 2018). The effect of game style on learning indicators has also been confirmed (Mosalanejad et al., 2018).

Blended learning and models, as well as their effect on learning, motivation, and learning indicators, are also emphasised in the shreds of evidence.

This pedagogical intervention with technology to enhance learning can be applied to educational methods and strategies and can affect the quality of learning. A practical context of medical education may be the best prerequisite for applying blended learning in various courses (Karamzadeh et al., 2021; Vallée et al., 2020). As part of research into the effectiveness of video games as a tool to help improve student performance in physical education, this study found that the factors studied included accessibility, enjoyment, technological competence, and learning through video games. These factors positively influence the acceptance of video games as a tool to improve student learning outcomes in the classroom (Merino-Campos et al., 2023). Other research shows that hedonic motivation is the most important factor for game adoption. Participants mentioned that collaborative and competitive elements enhance their gaming experience and influence their adoption of the game for learning purposes (Udeozor et al., 2023).

The above factors can inform the design of technology acceptance models suitable for game-based learning, also these factors confirmed the recent results of our study.

6 Limitations and suggestion

The following limitations can be mentioned in this study:

One of the limitations of the study was its application within one university and of course across different groups. Also, in running the application, we were faced with technical limitations such as low internet speed and internet outages during the program. Although this research tried to consider all the desired aspects and indicators, more research is needed in this area and its influence on learning indicators.

It is proposed that different aspects of gamification should be implemented based on indicators of learning and other blended learning models in future work.

7 Conclusions

With the growth and development of new technologies in education, the use of games and educational games is growing. Our findings offer new perspectives on gamification, as you can see through the results conducted in this paper, applying gamification in e-learning seems to have a great potential to increase engagement, performance, efficiency, motivation, and other emotional and social effects on the participants, whether students or trainees are willing to have that experience. The results obtained emphasise that they have varying effects on learners' motivation, as shown by previous research, furthermore considering the positive impact of educational intervention on learning through blended learning models and its impact on gamification acceptance among students, it is recommended to use this technology more widely in teaching medical science. It is also proposed to use learning enhancement technologies to promote and deepen learning. Blended learning models are also a good approach to using these technologies in education. Finally, it can be said that technology-enhanced learning

activities should be applied to medical education in Iran and the impact of the intervention on learning indicators should deeply be studied. In the end, if we want to refer to the actions and practical applications of this research, must say that the use of learning enhancement technologies in the form of gamification played a role in influencing student learning and memory in a motivating and visually engaging environment, also the implementation of this research increased the digital skills of students such as computer skills, skills of working with online platforms and game making skills because it was more practical for them to acquire these skills in the form of game making. Another practical measure of this research was that after obtaining effective results, other educational groups also used it to implement gamification in the form of blended educational program. Additionally, the instructional implementation process can be used as a design and implementation model by other researchers.

Ethical consideration

The proposal of the study was confirmed by the ethical committee at Jahrom University of Medical Sciences (IR.JUMS.REC.1397.098). All participants are willing to participate in the study.

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