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ORIGINAL RESEARCH ARTICLE

Evaluation of Three Mobile Game-Based Learning Games and Developing a Suitable Evaluation Model

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ABSTRACT

Purpose: The present article aimed to evaluate 3 mobile game-based learning games and propose a suitable evaluation model.
Method: The following games were utilized to evaluate games: farming simulator, tractor farm driver, and farm town. The appropriate evaluation method included 4 components of motivation, game environment, support, and Instructional design and the outcome of the model included learning and motivation.
Findings: The results obtained from experts' and students' analysis of the game support the correctness of evaluation results and the usefulness of the proposed model as a desirable model.
Conclusion: We may conclude that the evaluation of the three games mentioned above indicates the fact that this model can be suitable for evaluating games, especially computer and mobile games. **©authors**

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1. Introduction

Development of the mobile technology and its entrance to the domain of learning/education has changed the mission of educational institutes Such developments can even change educational methods (Gan and Balakrishnan,2017). For example, we may refer to a combination of mobile learning with learning games, which can result in a new approach to education known as mobile game-based learning (Yuan,2019). Although addressing the learning aspects and motivations of mobile games has great benefits for contemporary learners, (Lee, 2007; Hashim, Hamid & Rozali, 2007; Lu, 2008; Zaibon, and Shiratuddin, 2010; Fithriani, 2021), this should not distract our attention from its evaluation. Game evaluation is a process that must continue throughout the game procedure because the issues that are investigated in all phases of the game design are different from one another (Koyvisto & Korhonen, 2006). In the early phases of game design and production, attention are focused on game efficiency, but this attention is later shifted to game execution as time passes and the game develops. Through evaluations in different phases, the software can be upgraded, and a competitive advantage will be created for the company. An important term in game evaluation is a game test which is essential to "what the designer does throughout the design procedure to know what experience the players will have" (Fullerton, Swain & Hoffman, 2004). Thus, a game test essentially means that one must experience the game and take the role of the player. This is usually accomplished by Mobile game-based learning by executing the game sample in each phase of the production.

Concerning the increasing trend of mobile phones (smart ones with android OS) in various classes of Iranian society and also the fact that an evaluation strategy is needed to evaluate mobile games in terms of education and learning and their development, this study seeks to investigate evaluation, creative evaluation strategies of mobile-based games, appropriate evaluation model for game-based learning and evaluate three mobile game-based learning games based on the model presented.

2. Literature Review

2.1. Mobile Game-based Learning

Learning through playing games on a mobile phone or mobile game-based learning is a game that is especially used to learn on portable devices (Zaibon & Shiratuddin, 2010). Mobile game-based learning is a new approach that links mobile technology with education (Gan & Balakrishnan, 2017). Mobile game-based learning applications are designed for various learning contexts such as multiplayer and single-player games. Some of these applications are focused on cooperation, while others are quite contrary and are based upon single-player designs (Bensalem,2018). Mobile-based games are one of the fastest growing types of games in this industry which can support all types of game-based learning environments (IGDA[1], 2005).

2.1.1. Three mobile game-based learning games

2.1.1.1. Farming Simulator

A farming simulator is a farm simulating game. This game has strong content and various equipment so that the user feels he is a real farmer. Animal nursery, corps, and selling and managing and developing your farms are the duties of users.

Among the other facilities of this game are acting as a farmer in the 21st century, the vehicles of the greatest farming machinery companies, growing and selling products to buy machinery and new animals, tractors, mowers, plows, and Lochbihler.

[1] . International Game Developers Association

2.1.1.2. Tractor Farm Driver

It is an interesting and funny game that displays various stages of farming. In this game, the user is given a tractor which must be used to plow and manage the farm. This game can be classified as a strategy game. The user must manage the farm with the tractor he has. He must take care of his products and gain money by selling them.

2.1.1.3 Farm Town

It is a very beautiful and entertaining game for simulating farming and the user lives in a village, works on a field, and has some animals. He can sow various crops and harvest them. Gaining money helps him buy better and newer equipment and use them to develop his farm. He can keep farm animals such as cows, sheep, and hens and sell their egg and milk.

2.2 Mobile game-based learning evaluation

The development of mobile game-based learning applications for learning requires evaluation (Gan & Balakrishnan, 2017). Evaluation of the game in each phase of its production is an important procedure. Especially in the field of mobile-based games, evaluation can support the position of the game because nobody has any information about the comprehensive games and aspects which are parts of the gamers' experience in such games (Kriz & Hense, 2006). Another important term in game evaluation is a game test which is essential to "what the designer does in the whole process of designing to realize what experience the players will have" (Fullerton et al., 2004). Thus, game evaluation means that one must experience the game and take the role of the player. This is made possible by executing the game sample in each phase of production.

Few types of research have been conducted on the evaluation of Mobile game-based learning and each one proposes strategies for evaluation (Wang & Lai 2011). Zaibon, & Shiratuddin, 2010) believes that the evaluation strategy for mobile game-based learning consists of 4 components: playability, creativity, game execution, and learning content. The results show that these strategies are useful for applications similar to mobile game-based learning. In a

research titled "A framework for evaluation of mobile network games", Petrak (2005) proposes four elements for evaluation: communication, environment, user movement and group movement. Koivisto & Korhonen (2006) proposed three modules of evaluation: usability, movement, and executability, which are common for evaluating each mobile game.

2.2.1 Heuristics Evaluation Strategy for Mobile Game-Based Learning

Heuristics evaluation is developed for evaluating the effectiveness of an application and generally is the activity of using a set of guidelines (heuristics) to evaluate if an interface is user-friendly (Ling and Salvendy, 2009). This kind of evaluation is commonly applied in usability evaluation. A usability evaluation is conducted on users to find out how the users can easily and efficiently reach the application objectives (Tan, Liu & Bishu, 2009). There are many usability evaluation methods; most were originally developed by Nielsen & Molich (1990), and Nielsen (1993). The most utilized and useful usability heuristics were proposed by Nielsen (Nielsen, 1994; Muller, McClard, Bell, Dooley, Meiskey, Meskill, Sparks & Tellam, 1995). However, these heuristics are more focused on general applications and not specific to games. Malone created the first heuristics for evaluating educational games (Malone, 1980). In addition to not being developed for evaluating mobile game-based learning, the existing heuristics do not deal with mobility issues and do not cover learning content evaluation.

In particular, the heuristics evaluation strategy used in this study consists of four components: game usability (GU), mobility (MO), gameplay (GP), and learning content (LC). The GU components (Table 1) depict the interface and game controls with which the player interacts with the game. The game interface allows a player to play smoothly and react based

on user actions. In general, good game usability ensures that the player has the interest to play the game until the end.

Table1. Game Usability Components (Korhonen & Koivisto, 2006)

Number	Game Usability Components	Descriptions
GU1	Audio-visual representation supports the game	The game should look visually appealing. All graphics and audio should support gameplay and the story; consistent and informative to the player.
GU2	The screen layout is efficient and visually pleasing	The screen design should present all necessary information to the player and follow the general principles of good screen layout design.
GU3	Device user interface (UI) and game UI is used for their purposes	The player interacts properly with the game user interface and device functions. Full-screen mode is preferable.
GU4	Navigation is consistent, logical, and minimalist	All buttons and navigations should be organized reasonably, provide more clarity, and be easy to remember. The navigation should also be intuitive and natural.
GU5	Control keys are consistent and follow standard conventions	Standard control keys can be used since the player already knows from other games played.
GU6	Game controls are convenient and flexible	The game controls can be customized. The controls also should be designed based on the device's capacities.
GU7	The game gives feedback on the player's actions	It is preferred if the game user interface has a quick response to the player's actions. The feedback can be presented in graphics, audio, or tactile.
GU8	The player cannot make irreversible errors	The game should provide a confirmation message for actions that can cause serious and permanent damage. Recovery is allowed when mistakes happen.
GU9	The player does not have to memorize things unnecessarily	Minimum memory should be used minimally. Game user interface design and challenges are considered in this aspect.
GU10	The game contains help	The game provides instructions to the players for playing the game. manuals frequently.

In Table 2, the mobile components concern issues that affect the mobility of the game. Mobility can be defined as the ease of a player to enter the game world and the accessibility of the game anywhere and anytime.

Table2. Mobility Components (Korhonen & Koivisto, 2006)

Number	Mobility Components	Descriptions
MO1	The game and play sessions can be started quickly	The game sessions can be started quickly and easily, preferably in less than five seconds. There is a possibility to skip the game introduction.
MO2	The game accommodates the surroundings	Mobile games are played everywhere and this should accommodate the surroundings. The game audio volume can be conveniently adjusted or muted. The game should also put up with the device settings for instance, in silent mode.
MO3	Interruptions are handled reasonably	Interruptions such as incoming calls and messages are allowed during the play session. The player can pause the game at any time and continue to play later.

The 10 gameplay components (Table 3) describe how the game is playable, runs smoothly and consistently, is meaningful, and is not boring for the player. The gameplay components are important because it is dynamic and occurs when the player interacts with the game mechanics and rules.

Table3. Game Play Components (Korhonen & Koivisto, 2006)

Number	Mobility Components	Descriptions
GP1	The game provides clear goals or supports player-created goals	The game goals are provided clearly because having a clear goal in the player's mind is the core of an enjoyable experience. The goals can be either short-term or long-term goals.
GP2	The player sees the progress in the game and can compare the results	The game provides the game progress. The progress can be shown as high-score lists, rankings, character levels, or different titles.
GP3	The players are rewarded and the rewards are meaningful	The game should provide rewards as a player progresses in the game. It should be meaningful for the player and should be adjusted to the challenge.

GP4	The player is in control	The player should know what is happening in the game world. The player will be able to decide on actions they have to take for continuing in the game world.
GP5	Challenge, strategy, and pace are in balance	The game should not bore the player and he can choose the difficulty level. All game strategies and pace can be adjusted to the player's preference.
GP6	The first-time experience is encouraging	The game can create a good first impression of the game within the first five minutes. Completing the first play session should make the player wants to play the next play session.
GP7	The game story supports the gameplay and is Meaningful	The player can make his own decision in the game. The story is meaningful and fits with the game elements.
GP8	There are no repetitive or boring tasks	Task repetition without changing any conditions is not advised. This will give boring tasks to players.
GP9	The game does not stagnate	The player must know that the game progression and the game ending session should be indicated. There is also a possibility of starting the game again.
GP10	The game is consistent	Consistency in the game world is important. The game actions, flow, and design should work consistently and logically.

Lastly, the learning content components (Table 4) are specifically concentrated on the learning content. The learning content should provide users with informative, useful, and understandable content when playing mobile game-based learning.

Table4. Learning Content Components

Number	Mobility Components	Descriptions
LC1	The content can be learned easily	The game should provide easy learning content, that is not too complicated as preferable for the intended users.
LC2	The game provides learning content	The game provides learning content so that the users learn new knowledge from the game. It could be any information that is of interest to the users.
LC3	The learning objective from the game is achieved	The learning objective from the game is achieved after the game ends.
LC4	The content is understandable	The learning content is easy to understand and as expected by the users.

2.3. Features and the components that form the appropriate evaluation method proposed

The model proposed in this study consists of the 4 main components of evaluation: motivation, game environment, support, and instructional design. The outcome of this model which is shown by arrows includes learning and motivation.

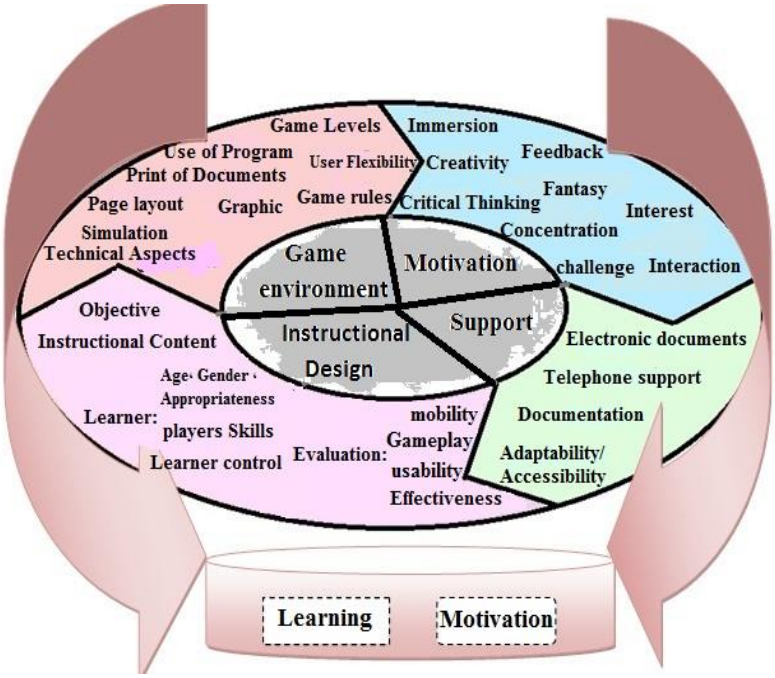

Figure 1. the appropriate learning model proposed

3.1 Game environment

The game environment acts as the medium between the internal and external factors of the game. In other words, it is the medium between the engine and the technical aspects of the players (Prensky,2001). The game engine can be simply defined as the link between the player and actions and reactions of the game which specifies the following factors: the operations associated with rendering images in the game, determining the physical clashes in the game environment, dedicating appropriate voices to different characters and environments, and the animations required in the game. The game environment includes 9 components each one, depending on its function, deals with the interaction of the player with the game environment to maximize the engagement of the players.

3.1.1 Technical aspects: the technical aspects of the game are defined as the motor engine and facility in playing the game. If a game is weak in terms of technical aspects, the player will be bored and quit the game no matter how attractive it is.

3.1.2 User's flexibility**:** user's flexibility is defined as the right to choose and greater freedom for the game user. The users will be more interested if the game has greater freedom and gives them wider ranges of choice.

3.1.3 Page design**:** page design is after design principles to maximize the user's facility.

3.1.4 Graphics/multimedia/voice/video**:** in an educational game, graphics are used to improve learning and optimize learning. Voices are also used as signs for the user.

3.1.5 Program use: for a game to be useful and easy to use, the appropriate information and exercises must comply with the age of the player, the reinforcement must be positive and repetitive, and repetition must be provided to achieve the mastery level. Good support of the exercise helps the user learn about subjects and use them whenever he wants.

3.1.6 Simulation: a simulation program is an activity that can engage the users in an unexpected and unreal event. As the simulated pattern gets closer to reality, learning will be more challenging and problem-solving activities will increase on the side of the user.

3.1.7 Document printing: the game must be free of any syntactic errors and they must be based upon a rational and organized method. If a user cannot read the instructions carefully or if the game has syntactic errors, players' engagement will decrease and users might even choose to quit the game.

3.1.8 Game levels: as the game level moves to harder stages, the user will make greater efforts to solve the problems and, as a result, the game becomes more challenging, exciting, and dynamic. In a game, the requirements for quitting the game levels must be defined clearly.

3.1.9 Game rules: the rules must be placed in the game in the form of what is right or wrong, good or bad, and just or unjust. All players must usually have this chance of success. Game rules impose limitations or boundaries and describe the goals of the game.

3.2 Motivation

According to Weinberg and Gould (2001), motivation is the most important factor in learning and entertainment. The intensity and length of one's stop in a particular activity such as a game influences motivation. Other factors such as physical limitations might also influence the behaviors, but motivation is one of the most important factors for engaging people in a particular activity.

3.2.1 Challenge: the challenge is known as the most important aspect of game design. The games must be sufficiently challenging, in line with the skill levels of the players, difficulty level, and the appropriate pace. If the challenges go beyond the skills, anxiety will be felt. If the challenges are less than the skills, indifference will break out (Johnson and Wiles, 2003).

3.2.2 Creativity: creativity is one of the most important aspects of thinking, it means the ability to provide new solutions for solving problems. McCarthy (2001) conducted research titled "the influence of computer simulation games on learning, education, intelligence and creativity" and concluded that using computer simulation games influences junior high school students learning and education, but has no effect on their intelligence. They also realized that such games influence the creativity of the students in the 2 modules of flexibility and fluidity.

3.2.3 Concentration: for a game to be delightful, concentration is needed and players must be able to concentrate. Greater concentration on one task requires attention. When all the relevant skills of an individual are required to cope with the challenges of a state, the attention of the individual will be fully absorbed in the actions. The games must keep the players thinking about speeding up their game 10 seconds, 10 minutes, 10 hours, or even 100 hours after the game (Pagulayan et al,2003).

3.2.4 Feedback: the game requires repetitive feedback in the game for the players to determine the distance and move towards the goals (Qin et al, 2004). Players must receive feedback about the time they have lost their progress, they must also receive feedback on why and how they are on the correct path (Pagulayan et al,2003).

3.2.5 Imagination: refers to the imaginary modules of the brain or an environment or sample of mental images. Imagination, as a feature of the game, can also be described as a motivational factor of the game. Malone (1981) believes that the state when learning content is contained in an imaginary module can be recalled much better. Rieber (1996) describes the relationship between educational content and imagination as endogenous imagination, the content becomes interesting when the imagination is also interesting.

3.2.6 Critical Thinking: creative thinking can be viewed as the ability to form a new combination of thoughts to fulfill demands. An educational game must provide an opportunity for high-level thinking skills and engage the learner actively. When a game encourages the player to have higher levels of thinking, more problem-solving opportunities will be provided for him.

3.2.7 Immersion: the players must experience the deep experience of getting engaged in a game. Immersion is the interaction between thoughts that are repetitively discussed and it is very important in the design of the game and research. This element of flow is a description of deep immersion and engagement which can be the result of losing anxiety, daily life, and a modified sense of time. Deep but engaged is usually reported by the players and those who are watching it (Johnson and Wiles, 2003).

3.2.8 Interaction (Individual and social): social interaction is not an element of the flow and can even disrupt immersion in the game, just like the way communications in the real world can drive the players out of the imaginary world of games. However, it is a strong element of game pleasure, just as players play games for social interaction (Lazaro and Keeker,2004).

3.2.9 Interest: interest is a state in which the learner focuses carefully on a goal or activity and prefers it to other things. He is satisfied with and enjoys the attempts he makes on this path (Fardanesh, 2004). In this respect, Keller (1987) says that if curiosity is invoked during the game and should it continue over time, it will be attributed to his interest and desire.

3.3 Support

3.3.1 Electronic Documents: in each educational game, the existence of forums where users can participate to solve their problems is a necessity. These forums result in further interaction between players and solutions to their problems.

3.3.2 Telephone Support: game support can be either technical support or telephone support. Telephone support of the game must be available the whole time of the day in an appropriate way to provide correct solutions to problems. These supports must be available through a free phone line without any extra costs for the user.

3.3.3 Documents and materials supporting teacher and learner: the set of the activities of the teacher and learner and supporting documents to provide useful recommendations on merging the application with the curriculum, useful recommendations for class preparation in a certain hardware condition, and grouping of the students, a clear description of the content, useful recommendations about class activities while using the program. Teachers and students must be able to pursue their progress easily through feedback or other documents.

3.3.4 Compatibility/Accessibility**:** in a game, we must have a cultural variety of content and the contents must be compatible with the unique learning style products and various levels of the user's capabilities. Fonts must be clear and text reading properties must be available for those people with eye problems.

3.4 Instructional Design

When predictions and regulations are made about the access method to a series of knowledge and skills as educational goals, Instructional design is conducted. Thus, instructional design can be considered as prescribing or predicting appropriate educational methods to achieve the developments we seek in the knowledge, skills, and emotions of the students (Fardanesh, 2004). Among various planning elements, 4 of them are very important in Instructional design. These 4 elements can be observed in almost all models of Instructional design. These elements could be stated in the form of the following questions:

1- who is the planning intended? (learners' characteristics)

2- what do you expect the learners to learn or display? (goal)

3- what is the correct method of learning the educational content or skill? (Educational strategy)

4- how do you define the learning criteria? (Evaluation practices)

These 4 fundamental elements – learners, goals, methods, and evaluation – create a framework for systematic planning. These elements have internal relationships with one another and form the whole map of an educational plan. Other elements should be considered (for example, the context in which the learner learns and works), and when combined with the four basic elements, a complete instructional design model is created.

3.4.1 Learner: The learner is a key factor of education in such a way that he is the origin of all educational activities. Heinich, Molenda, Russell, and Smaldino (1999) proposed that designers consider three sets of the learner's characteristics: general characteristics, special entrance characteristics, and learning styles.

General characteristics include variables such as gender, age, work experience, education, and culture. Especial entrance characteristics are prerequisite skills and attitudes that learners need to have to benefit from an activity such as a game.

The way people deal with learning assignments and information processing is called learning style. Games have various learning styles. According to Bergeron (2006), the list of the standard game-based learning styles is as follows: action, adventure, entertainment, fighting, driving, first-person shooting, puzzle, simulated real-time, role play in the game, simulation, sports, strategy, and third-party shooting. Thus, players must be able to personalize the controls and gameplay by learning and playing style (Baharom, Tanand, and Idris, 2014).

3.4.1.1 Age/Class/compatibility: an educational game must be compatible with the age and class of the users. This could be accomplished in the form of the compatibility between the level of reading and instructions with the work which must be done. It must be clear enough.

3.4.1.2 Learner's control: in line with the flow of the experience, players must be permitted to have a sense of control over their actions. Players must have enough capabilities to translate

their intentions into game behaviors and use their methods and mood when they feel themselves in their surroundings (Federoff,2002).

3.4.1.3 Players' skills: games are enjoyable when they support the development of the player's skill and dominance. The perceived skills of the player must match those of the game and both challenges and skills should go beyond a certain threshold. Thus, players need to develop their skills in the game to enjoy it (Desurvire, 2004).

3.4.2 Clear goals: games must prepare the players with clear goals at the appropriate time. The games must have only one purpose or goal, but the goals must be clear to attain the flow (Johnson and Wills, 2003). Through a clear and important goal which is usually shown in the form of the demo at the beginning of the game, the players must be prepared. These goals must be told to the player directly and clearly (Pagulayan et al 2002).

3.4.3 Content: based on the game style and the level of difficulty, time, feedback, attempt, and effort for creating variety in the situational context and complexity, the learning content must attract the attention of the players. Freshness, surprise, and satisfaction (although the latter is challenging) must also be considered. Content in the games must go beyond the initial principles and encourage learners to higher levels of thinking and engage them in applying what they have learned.

3.4.4. Evaluation: evaluation is an inevitable part of instructional design. Evaluation is not a procedure that takes place by the end of the project and after the termination of educational credit. It is not done just once, on the contrary, it is a continual procedure that must start in the early phases of design and repeat in various stages.

3.4.1.1 Game Usability evaluation: game Usability e evaluation is designed for the evaluation of the user's interface of the software. Users usually have goals that try to know how they can achieve them with ease. In the games, the goal is a pleasure. Learning for game execution, problem-solving, or discovering something new is also a part of the experience.

3.4.4.2. Game Mobility evaluation: game Mobility consists of three components that are associated with the factors that influence game mobility. Mobility can also be defined as how easily a player can enter the world of the game and access it anytime anywhere.

3.4.4.3. Game Play evaluation**:** game Play deals with the mutual effect structures of the player with the game system and other players (Bjork and Holopainen,2005). Games mechanism includes the defined rules and laws of the game world and coded machines (Adams, 2010). The game execution is made possible only when players interact with the game mechanism and other players and game execution is the heart of the game.

3.4.4.4. Evaluation/effectiveness: the learning methods in an educational game must be challenging, appropriate, and compatible with educational goals so that the experts can easily evaluate the progress of the players by the results presented inside the product.

3. Method

The present research is based on surveys. To determine the appropriate model of evaluation, the researcher-made checklist was used to evaluate three mobile-based learning games. The study population included all the new coming M.A. students of educational technology in South Tehran Branch Islamic Azad University and the Kharazmi University of Tehran, totaling 90 people.

3.1. Sampling method

10 students were chosen from the study population to evaluate three mobile-based learning games. Evaluation checklists were also distributed among 20 students of the experiment group to evaluate the three games.

3.2. Data Collection Tools

A researcher-made checklist was used to evaluate the three games. Various theoretical studies were conducted on game evaluation. After investigating evaluation elements and components, the researcher summed up the 4 key components and 32 sub-components of evaluation which were put in the evaluation checklist after consulting with the advising professors. Concerning the evaluation of mobile game-based learning, this checklist measures 32 components: content, age, effectiveness evaluation, technical sides, page making, graphics, critical thinking, document publishing, electronic documents, telephone support, the materials and documents which support teacher and learner, application use, creativity, learner control, feedback, simulation, compatibility/accessibility, game levels, challenge, imagination, goals, immersion, interaction, game rules, concentration, players' skills, interest, Game Usability evaluation, Game Mobility evaluation, game Play evaluation, Instructional design and application flexibility. Content and face validity measures were employed to assess the validity of the checklist.

Using the opinions of experts, including six Ph.D. in educational technology, the validity of the checklist was evaluated and the checklist was refined based on their comments.

After designing the checklist, 10 M.A. students of educational technology of South Tehran Branch Islamic Azad University were assigned to study the questionnaire, play the games (Farm simulator, farm tractor driver, and farm town), and give each subcomponent-component a score from 0 to 20. At the end of each component, a total score (0 to 20) is given to that. The least and the most score for each component were respectively 0 and 20. Based on this checklist, another checklist based upon the level of the students was designed and given to 20 students in the control group. Their scoring method was just similar to the previous group.

4. Findings

In the present research, 10 M.A. students of educational technology played the games and were then assigned a score from 0 to 20 based on the evaluation components of each one. To evaluate the game through the model, the evaluation scores were set to 7 levels. If the score ranges from 0 to 3, the game is unusable; if the score ranges from 3 to 6, the game is unsuitable; if the score ranges from 6 to 9, the game is relatively unsuitable; if the score ranges from 9 to 12, the game is weak; if the score ranges from 12 to 15, the game is relatively suitable; if the score ranges from 15 to 18, the game is suitable; and if the score ranges from 3 to 6, the game is excellent (Table 5).

Table 5. evaluation score range

Range	Level
0-3	Unusable
3-6	Unsuitable
6-9	Relatively unsuitable
9-12	Weak
12-15	Relatively suitable
15-18	Suitable
18-21	Excellent

After collecting the evaluation checklist, the mean of the scores was calculated. As one can see in the following charts, the mean of the scores assigned to the 32 evaluation components is presented.

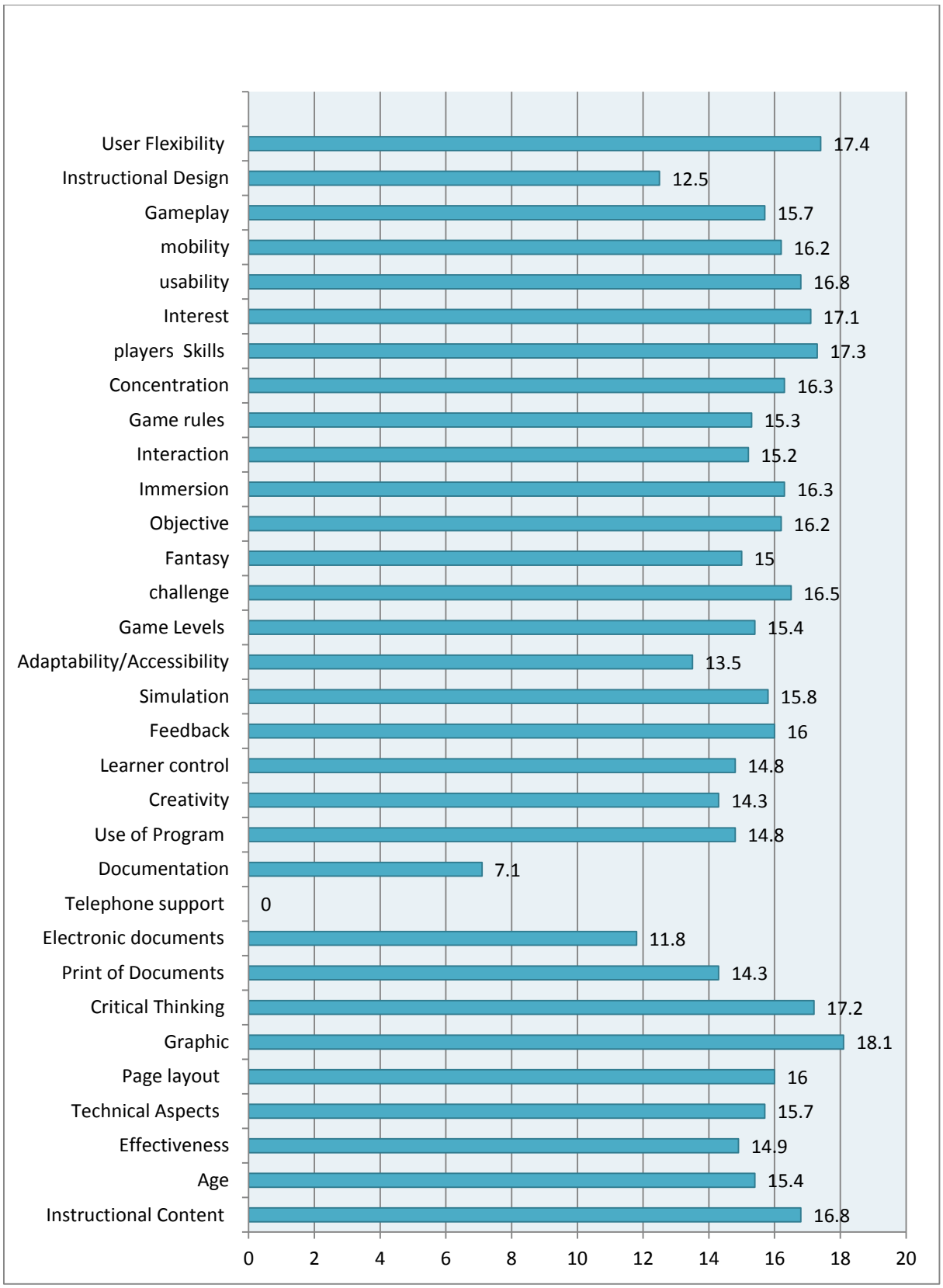

Chart 1. The mean of the scores assigned by the experts to the farming simulator

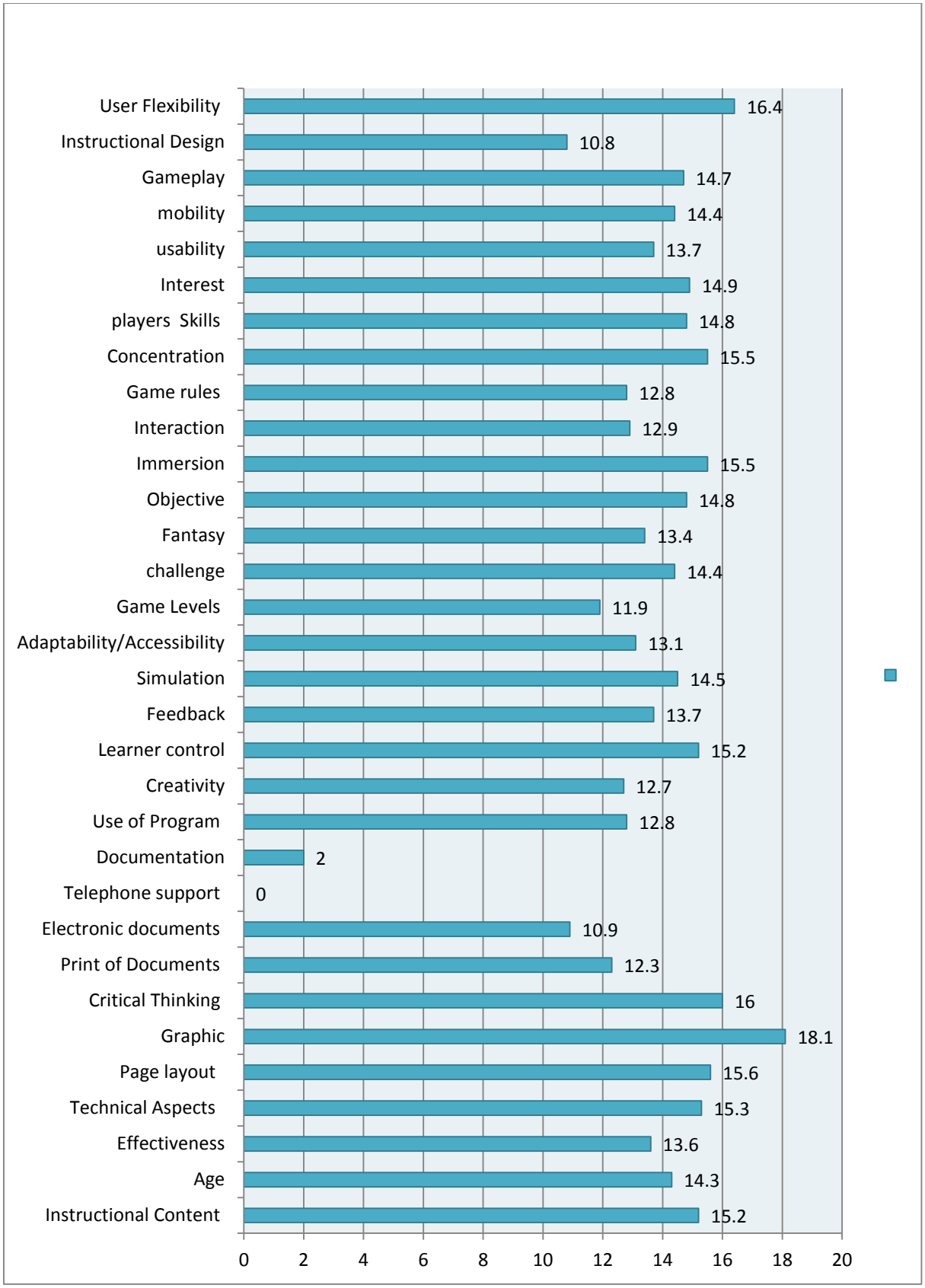

Chart 2. The mean of the scores assigned by the experts to tractor farm driver

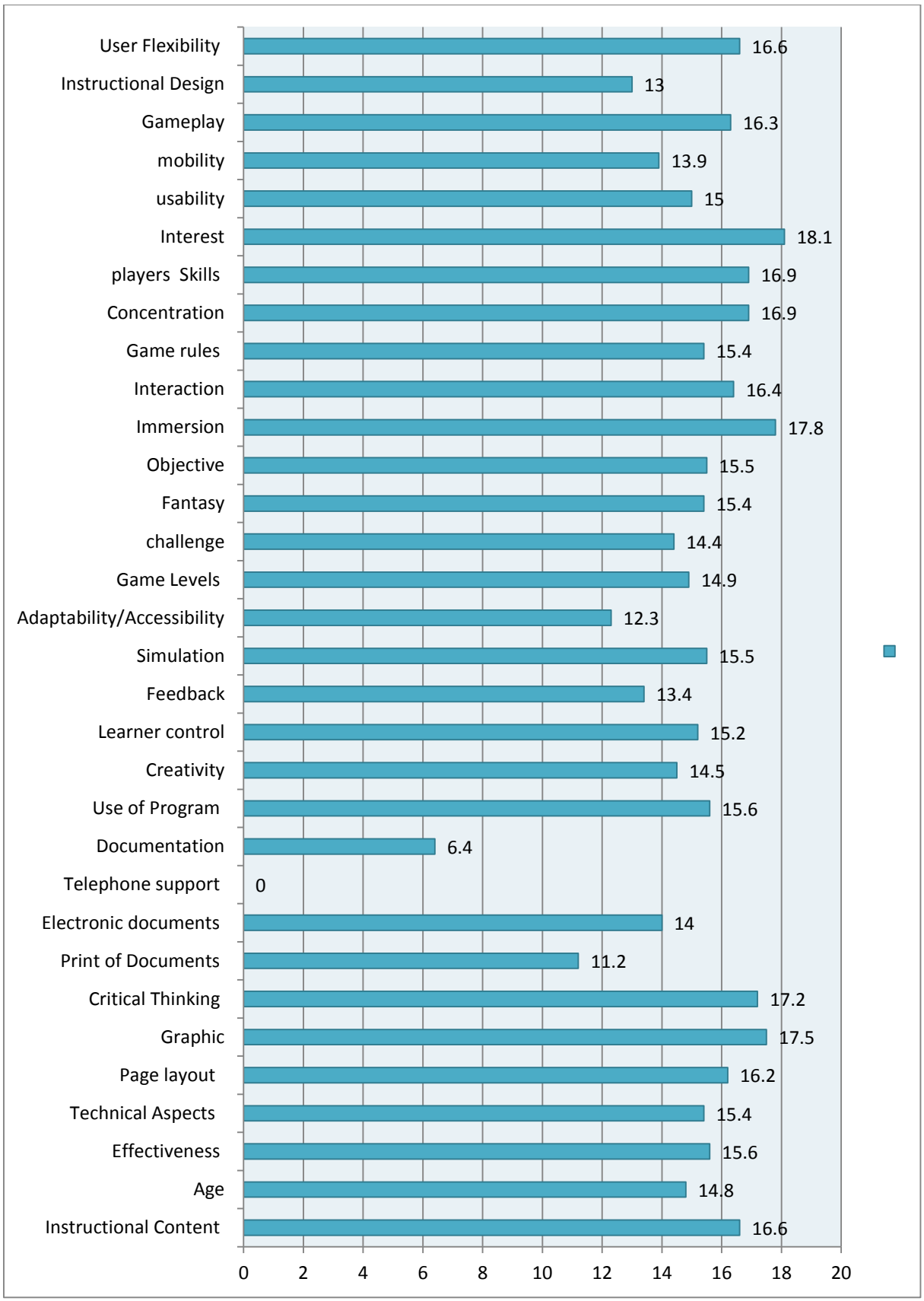

Chart 3. The mean of the scores assigned by the experts to the farm town

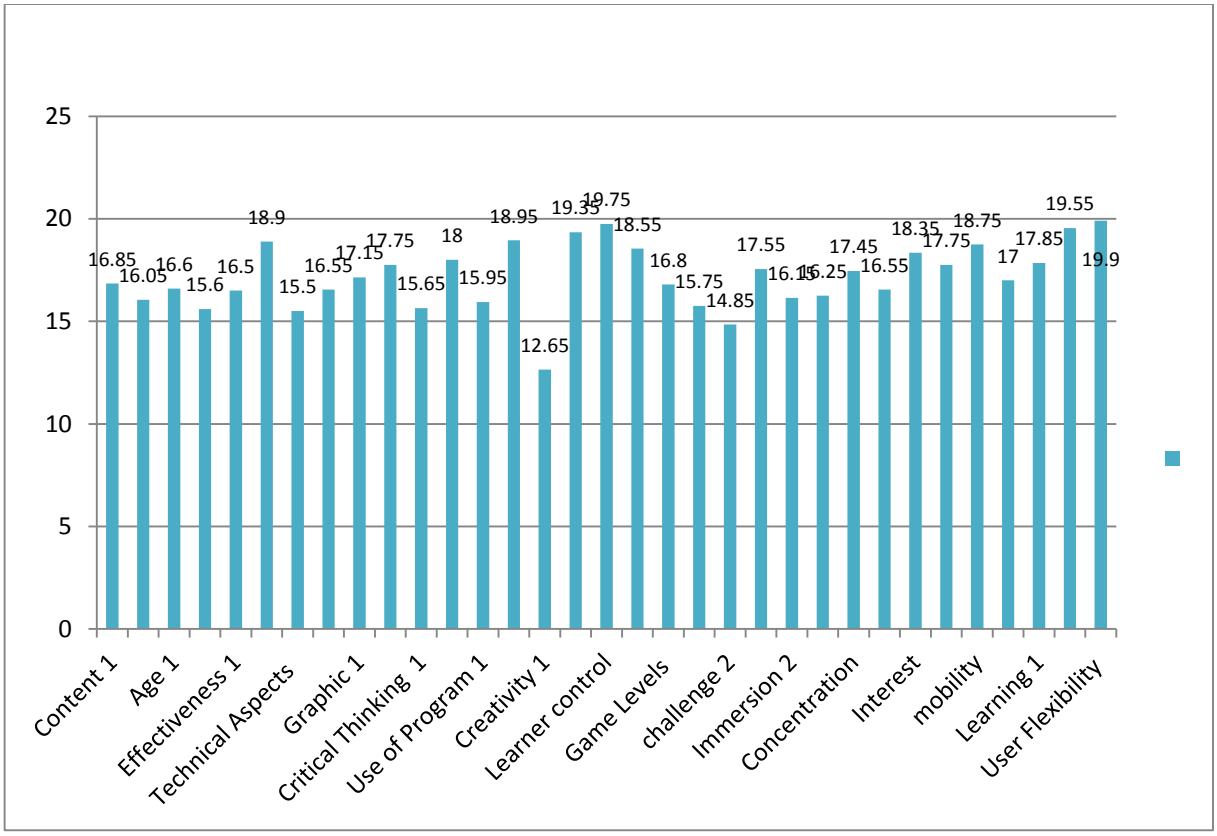

Chart 4. The mean of the scores assigned by the students to the farm simulator

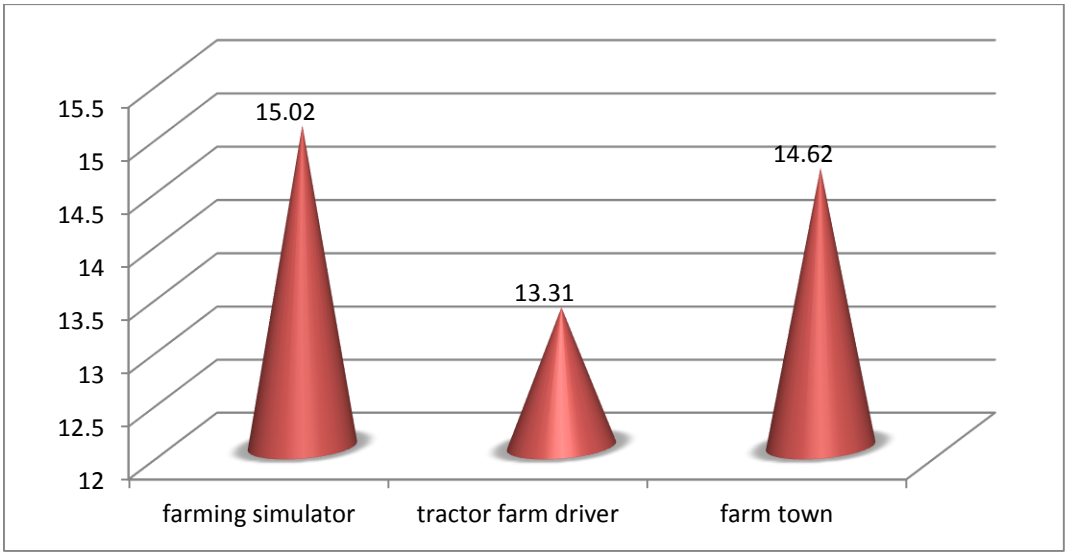

Chart 5. The mean of the total score for experts' evaluation of 32 components of three games

After calculating the mean of the scores of the experts for each of the 32 components in charts 4-5, the mean of the total evaluation scores of the experts for 32 components was calculated and the evaluation score of each game was determined. The farming simulating game was appropriate with a score of 15.02, the tractor farm driver game was relatively appropriate and somehow weak with a score of 13.31, and the farm town game was relatively appropriate with a score of 14.62.

After calculating the mean of the scores of students' evaluation of each component of the game, the total evaluation score of the students for all components was calculated and the total

score of the Farming Simulator was determined. The total score assigned by the students to this game was 17.17 which renders it appropriate.

5. Discussion

To evaluate, three mobile game-based learning games were selected and evaluation checklists were given to students and experts. The results indicate that the three games evaluated by the model recommended are useful for game evaluation.

One of the main components of the recommended model is motivation. Motivation is one of the benchmark features of learning and plays a major role in encouraging learners to scientific activities. Mitchell (1982) notes "motivation displays the psychological processes which are the cause of arousal, direction, and stability in voluntary and goal-based activities. Steers and Porter (1991) believe when we discuss motivation, we will first consider these issues: 1. What reinforces human behavior; 2. What guides such behavior; 3. How is this behavior supported and preserved? According to Bandura (1991), motivation is a multidimensional and listed phenomenon with a terminology of the interventional determinants and strategies which influence the supported choice, activation, and direction Quoted by Campbell (2007). Keller's ARCS model (1987) is also based upon this hypothesis that if the learners feel they can achieve success and their learning is precious, they will get motivated. The acronym ARCS is used to summarize the four motivational categories that Keller considers. His classification includes attention, communication, trust, and satisfaction. Based on these points, the strengths of the model proposed in the motivation component can be interpreted as follows: many of the psychological theories such as the theory of documents, value expectancy theory, and goal theory support motivation, and many motivation components of evaluation model overlap with Keller's model. components of interest, concentration, challenge, imagination, and immersion overlap with Keller's components of attention, interaction, communication, feedback, and satisfaction.

The other component of the proposed model was the game environment. As previously mentioned, the game environment acts as a medium between a game's internal and external factors. One of the strengths of the proposed model was that it dealt with the components of the game environment. It determines how players interact with the game environment and maximizes game engagement, enhances learning, and optimizes it. Thus, the game environment plays a major role in engaging the players in the learning process. Thus, it can be considered a strength of the model.

The other component of the proposed model was support. Support is considered to be one of the points of the strength of the proposed model because it has useful recommendations concerning merging the application with curriculum, class preparation in some sort of hardware conditions and student grouping, a clear description of the content subject, class activities while using the application, and a clear description of education activities. Thus, guides for students, fathers, mothers, and teachers will be specified, extra resources such as websites, bibliography, etc. which are useful for the course are defined, and teachers and students will be able to pursue the progress easily through feedback or other documents. The results of the evaluation of these three games indicate the fact that the mobile-based learning games we have studied have major weaknesses in terms of support and the majority of their subcomponents are at an unsuitable level. Thus, one of the proposed model's strengths was the attention paid to support, which prevented many of the game's weaknesses. As previously mentioned, Reiser and Dempsey (2007) describe Instructional design as a systematic process used consistently in developing educational and training applications. More specifically, Instructional design focuses on results and goals, while the game design is focused on game and interaction. The goal of designing successful games is to create meaningful games, while the goal of successful Instructional design is to create meaningful learning experiences (Salen and Zimmerman, 2003). Thus, one of the strengths of the proposed model which is neglected in many game design models is the attention paid to Instructional design. The recommended model is capable of moving towards

significant learning in learners by referring back to goals and content and making good use of Instructional design models in each phase of game production. Among the other strengths of the recommended model, we can point to the application of a very strong theoretical foundation and also the outcome of the model which makes it possible to test the game on the learning and motivational level of the learners.

As for the weaknesses of this model, we can refer to the following points: no investigation of ethical components in-game evaluation (many of the games are not congenial with the ethical and moral bases, this pattern has ignored evaluation of ethical components), no accurate investigation of the game script, description, and publication of the game, and the educational psychology bases used in game design.

Based on the results attained in the evaluation of mobile game-based learning games, we may conclude that the proposed model can be useful in the evaluation of educational mobile-based games. The 32 components introduced for game evaluation cover motivation, game environment, support, and also Instructional design. The results of the evaluation of three mobile-based games show that this evaluation model can be appropriate.

The results of this research on mobile game-based learning evaluation are consistent with the results of Shiratuddin and Zaibon (2010), Petrak, Landsiedel, and Wehrle (2005), and Koivisto and Korhonen (2006).

In the description of the results attained in this research about the evaluation of three games with the recommended model, we may refer to various reasons for the usefulness of the components and elements proposed in the model which render it suitable. As previously mentioned, motivation is the moving force of recent interests in games with educational purposes. The importance of motivation is stated well in Keller's model. Keller (1979) says that if learners feel they can achieve success and their learning is precious, they will get motivated. Another reason for the usefulness of the proposed model is Instructional design. Generally speaking, design is a kind of problem-solving and Instructional design is a very creative process that views education from the attitude of the learner. Learners can use it to display their new knowledge, skills, and attitudes. Thus, Instructional design in-game includes solving educational problems with a systematic analysis of the learning conditions and a satisfactory learning experience for players based on this analysis.

6. Conclusion

The favorable model of evaluation includes the 4 components of motivation, game environment, support, and Instructional design, while the output includes learning and motivation. Among some strengths of this model, we can refer to the support of psychological theories such as documents theory, value expectancy theory, and goal theory from motivation and also the overlap between acronyms of Keller model with many components of motivation of evaluation model. another strength of the proposed model is the use of strong theoretical bases and also the outcome of the model which makes it possible to test the game against the level of learning and motivation of learners. The following points can be considered the weaknesses of the proposed model: no consideration of ethical points in game evaluation, no detailed analysis of the game script, distribution, and publication of the game, and the educational psychology basics used in game design.

The three games evaluated with this model indicate that this model can be used as an appropriate and useful model for evaluating games, especially mobile-based games. The results of the analysis and evaluation of the students and experts of the game are a reason that confirms the correctness of the evaluation and efficiency of the proposed model as an appropriate model.

Declaration of Competing Interest

The author declares that he has no competing financial interests or known personal relationships that would influence the report presented in this article.

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