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Review Paper

Design Considerations for 3-D Exergames

Bahattin Selim Pamukcu[*a], Hasan Çakır[b]

[a](ORCID ID: 0000-0002-4209-7109), selimpamukcu@gmail.com
[b](ORCID ID: 0000-0002-4499-9712), Gazi University, TURKEY, hasanc@gazi.edu.tr
[*]Corresponding author

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ABSTRACT
To increase the benefits of three-dimensional exercise games, the steps to develop these games need to be effective and efficient. The purpose of this study is to determine the game development model used in the design of three-dimensional games for exercise to create effective, efficient, usable, and safe games for users. In this article, studies on exercise programs and game development models in the literature were examined. According to the results from the literature, the considerations which should be taken into account when designing the three-dimensional exercise games are: creating user-specific exercise training programs, having game and gamification elements, providing expert support in determining an exercise program, having rich tools for measuring and evaluating physical activities, providing feedback about short and long term user performance, and that it can be used independently in the home environment.

INTRODUCTION

Instructional design and technologies include industrial, military, health, education, etc. performs studies to produce systematic solutions to eliminate performance-based educational problems in various fields and to increase this performance positively (Metzler, 2017; Reiser, 2001). The instructional design field reveals different educational materials using all kinds of innovative technologies to ensure effective learning and traditional teaching processes (Hokanson & Miller, 2009).

Various studies have been carried out using traditional instructional design and technologies to increase performance outcomes in training for exercise to gain awareness of healthy life (Bailey, 2006; Metzler, 2017). In addition to these studies, there has been a numerical increase in the research conducted on interactive games that aim to exercise health education (Nawaz et al., 2016). In these studies for exercise, by using innovative technologies such as interactive games, there is generally a tendency to select the available interactive games available and adapt them to the topic chosen during the application process (Chang et al., 2012; Geurts et al., 2011).

These systems, which can be used primarily in the home environment, provide low-cost, broad, and target-oriented instantaneous feedbacks as the reason for the trend in this research (Bronner, Pinsker, & Noah, 2015; Harrington, Hartley, Mitzner, & Rogers, 2015). In adopting or developing the material, besides the technology preference, the teaching model should be determined carefully (Hokanson, 2001; Kozma, 1994; Metzler, 2017). Establishing the teaching model and technology preference adaptively allows learning to achieve supportive results (Hokanson, 2001; Metzler, 2017). As in other instructional design processes, it is possible to determine the needs analysis by the targeted behavior acquisition and reach the performance outputs expected to be followed for a long time in developing innovative instructional materials for exercise (Nawaz et al., 2016). It can be considered the first step to reaching the targeted performance by analyzing the subject planned properly in material design processes and determining the needs.

The purpose of this article is to create a model to be followed in the development of a customizable three-dimensional game for exercise. The tendency in studies about three-dimensional games for physical activity is that the existing games are preferred and used for exercise purposes. In this study, the game development models, which are thought to be appropriate, were determined by examining the needs related to exercise. The design considerations that should be followed in three-dimensional games for exercise were explained.

AWARENESS OF HEALTHY LIFE

The concept of healthy living means not only physical illnesses but also socially and spiritually in good condition. The World Health Organization (WHO) has described individuals' right to healthy life regardless of their religion, language, race, or political opinion as a necessity of being human. Based on this requirement, countries and organizations such as WHO have taken various steps to protect people's health (WHO, 2000). These steps can be considered as well as making the necessary treatments to regain physical

fitness in case of illness, and actions are taken for individuals to gain awareness of healthy living (Frank-Stromborg & Olsen, 2004; Şen et al., 2017).

Protection of Health

Countries and health organizations provide a healthy living environment by regulating environmental factors for the measures to take for the protection of health. At the same time, it is of similar importance for individuals to gain healthy living behavior for a healthy life. When the periods in the health protection process examined respectively, it is gathering under three headings: primary protection (preventive measures), secondary protection (early disease period), and tertiary protection (late disease period) (Bilir, 2007; Richmond, Kehoe, Heather, Wodak, & Webster, 1996). Although the significance levels of these three periods are not different from each other, the first period for a long, healthy, and quality life is a period that individuals should attach importance to (Bilir, 2007).

PHYSICAL ACTIVITY, EXERCISE, AND SPORT FOR HEALTH

Ensuring physical mobility is just one of the measures that can take for healthy living. In the primary prevention period known as the preventive disease period, "physical activity and exercise" are considered the most effective step to prevent many diseases mainly related to obesity, diabetes, heart conditions, etc. it is (Akyol, Bilgiç, et al., 2008).

Physical mobility, which is indispensable for the protection of healthy life, can cause various accidents and injuries if done wrong. One example of such situation is that the healthy individual's physical mobility is inconvenient to try to be done by an individual with limited mobility. Differences between individuals, goals, etc., all factors depend on the type, severity, duration of movement, etc. affect the variables (Blair et al., 2004). Generally, physical mobility; is examined under three main headings: physical activity, exercise, and sports (Akyol, Bilgiç, et al., 2008; Caspersen et al., 1985).

Exercises

Exercise is the physical movement that is specially designed to protect and improve our health, planned well, and repeated within the specified period (Akyol, Bilgiç, et al., 2008). The exercises to be done should prepare according to the goals of the individuals. For example, if individuals have goals to increase flexibility and strength for their purposes, exercise programs should be developed accordingly (Baltacı & Düzgün, 2008).

In addition to exercise goals, individuals' physical fitness should be controlled during the development of their programs. According to the physical suitability results obtained, determining safe exercises is essential in terms of not affecting the health status of individuals who will exercise. For example, while the majority of the practices to be performed by a candidate mother during pregnancy are walking and swimming activities, these exercises can be musical movements in sitting position in individuals with limited mobility (Akbayrak, Kaya, & Therapy, 2008; Lök & Lök, 2015).

It is another factor that should be given importance in this process to prove whether individuals have reached the specified targets within the scope of the exercise program planned by the experts (Laporte, Montoye, & Caspersen, 1985). The methods and tools used to determine the level of completion of the exercises, which consist of different sizes, also vary. When we think that there is more than one variable to reach the goals as a result of the exercise, the measurement of these variables can be performed with more than one tool or method (Bulut, 2013; Laporte et al., 1985). An example of this is the use of heart rhythm and motion sensing devices at the same time.

WEAKNESSES IN THE APPLICATION OF EXERCISES

Some weaknesses arise during the implementation of exercise processes. These are:

- Measurement methods that are used were not appropriate for exercises.
- The differences in the planning of the activities are not taken into consideration.
- The motivation that will provide continuity in the practices cannot be created.

Measurement Methods That Are Used Were Not Appropriate for Exercises

Exercises must be measurable to achieve targeted success. In other words, measurement is necessary to check whether the tasks are done correctly and document the changes created by mobility. Determining the level of activities performed by measuring contributes to taking measures to prevent the health problems that may arise due to the wrongness of the exercises and achieving the goals of the individuals participating in the activities and following them (Blair et al., 2004). There are different applications in the measurement of exercises. These applications are based on the target, the number of participants, physical suitability of the participant, budget, etc. may differ depending on the situation (Bulut, 2013; Felix & Tmeson, 2017).

The Differences in the Planning of the Activities Are Not Taken into Consideration

Measuring the physical suitability of participants and preparing the exercise programs according to these data contribute to the determination of the physical activities suitable for the target and the creation of the plans by finding the individuals' strengths and weaknesses. It should be remembered that the exercises to be performed for a quality life should be done regularly, correctly, and following the purpose as planned (İnanıcı, 2007).

The Motivation That Will Provide Continuity in the Practices Cannot Be Created

In studies that use motion detection systems with video games, it is seen that the interests of individuals playing video games affect positively (Chang et al., 2012; Temizkan & Ekici, 2018). The participation of individuals who use these systems by own accord in the activities will play an essential role in achieving behavior acquisition and maintaining the acquired behavior (Akbaba, 2006; Alahäivälä & Oinas-Kukkonen, 2016). Individuals who are motivated against the activity can show more effective results in the processes. In other words, it has been stated that the individuals who use the systems by own accord reach the optimal level, which is ideal in terms of motivation levels, enables individuals to reach their targeted goals more easily and quickly (Akbaba, 2006).

In researches aimed at increasing the level of motivation, studies related to game and gamification, especially video games, continue to be carried out on various topics and all over the world. The video games (exergames) developed for exercise in recent years have contributed positively to individuals' motivation due to entertainment factors (Alahäivälä & Oinas-Kukkonen, 2016; Matallaoui et al., 2017). The level of motivation created by the games has increased by changing interactions in these environments (Alahäivälä & Oinas-Kukkonen, 2016).

USING GAMES AS AN ALTERNATIVE IN EXERCISES

The game and gamification applications made for an exercise called by many names like fitness games, exercise games, etc. allow users to exercise with technologies based on tracking body movements and reactions by playing video games. These systems, which add physical mobility to the lives of individuals with a sedentary lifestyle, claim that they eliminate the concept of still life, one of the generalizations created by video games. It seems likely that the existing structure will increase physical activity when examining digital solutions using games and gamification for exercises (Benzing & Schmidt, 2018; Oh & Yang, 2010).

Research on exercise and gamification has been conducted since 1980, studies in recent years have increased the importance of these systems. They have made them a popular topic in healthcare applications. In addition to health practices, this system has been used in sports, psychology, nerve, and computer science, and has been the subject of interdisciplinary research. Although the research target group was from childhood to old age, when the focus group of the study was examined in terms of particular interest and benefit, they became young users (Baranowski, 2016; Benzing & Schmidt, 2018). The academic studies indicated that the expected results of the games and gamification developed for exercise differ in terms of physical, cognitive, and psycho-social goals. Besides, these systems, which use innovative game mechanics based on physical activity, have been commercially seen by many game developers, although they aim to increase physical mobility. In this context, many applications have been developed that can be used for exercise. The results obtained by these systems, which have various targets, especially the development of the physical activity, differed (Baranowski et al., 2012; Daley, 2009). It has been stated that the results obtained will occur depending on various factors when examined in terms of the advantages and disadvantages of these systems (Baranowski, 2016).

The History of Computer Games for Exercises

•Before 2000: Exercise-oriented games, which started with the use of virtual reality in the 1980s, were also being designed. It was possible to control the games developed by the Bandai Company under the name "PowerPad" and produced by Nintendo under the name "Family Fun Fitness." The controller named PowerPad is located in Figure 1 (Bogost, 2005).

In the 1990s, with the increase of popularity of virtual reality, systems such as “Dance Dance Revolution” were developed during the development of cycling equipment with screens, and so on. With this system shown in Figure 2, it is expected that the players will perform the movements according to the music played in the order (Bogost, 2005).

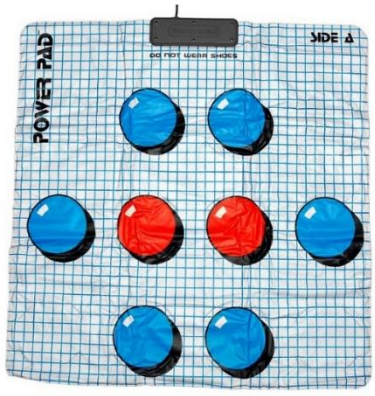

Figure 1. Image of the game controller named PowerPad

Figure 2. Image of the game controller named Dance Dance Revolution

•2000 - 2010: In 2006, Nintendo entered the market with "Wii Fit," "Wii Balance Board," and "Wii Remote." However, many companies have developed controls for exercise to use in-game consoles (Bogost, 2005). Camera-assisted motion sensors, footpads, and exercise bikes are some of these controls (Sinclair, Hingston, & Masek., 2007; Stach, Graham, Brehmer, & Hollatz, 2009).

•After 2010: With the release of Microsoft's Kinect® motion sensor used with Xbox, the number of games developed in this area has increased. With the use of augmented reality applications with mobile devices at the same time, the popularity of games that support exercise has increased (Bogost, 2005). Examples of these systems are Pokémon GO and the Yourself!Fitness (in Figure 3).

Figure 3. Image of the game named Yourself! Fitness

RESEARCHES ON THREE-DIMENSIONAL GAMES USED IN EXERCISE PROCESSES

Whitehead et al., in 2010, developed a video game with eight movements for an immobile lifestyle causing many diseases such as diabetes and heart diseases as well as obesity, which is a cause of early death and tested with fourteen participants in their studies. This game has been compared with video games for energy expenditure on the market under the titles of entertainment, energy consumption, and heart rhythm. The obtained results showed that the developed study was more effective than other software available in the market. Still, the researchers said that long-term research should be done to provide more precise results. Besides, it was stated that individuals' game preferences affect the outcome in these studies (Whitehead, Johnston, Nixon, & Welch, 2010).

Staiano and Calvert (2011b), examined whether three-dimensional games used for exercise serve their real purposes on the effects of these systems on body health. Studies conducted using these systems were reviewed, and according to the data obtained, it was mention that the studies with externally used equipment should be continued for the health data collected with these devices to be more valid and reliable (Staiano & Calvert, 2011b). In a different study by Staiano and Calvert (2011a), it was examined whether the gains obtained from the games played for exercise were transferred physically, socially, and cognitively. When the studies conducted are considered, the data collected have shown that the results are positive even though they can be transferred limitedly (Staiano & Calvert, 2011a).

Sinclair et al. (2007) researched how to adapt the principles of sports science to today's technologies and what should be considered in exercises to ensure effectiveness in this research, which provides design suggestions for the use of three-dimensional games to be used for exercise purposes. He stated that indicates that the most crucial factor is to keep the users connected to the system while supporting the exercise, and the follow-up process is also essential in the study (Sinclair et al., 2007).

Peng et al. (2011), in a meta-analysis study on the effects of three-dimensional games for exercise purposes, researches were identified and analyzed according to specific keywords in the research published between 1995 and 2010. The study that examines the concepts of heart rhythm, oxygen consumption, and energy consumption according to exercise type, player age, and weight of the player concluded that the use of these systems had positive effects. This system would be appropriate for moderate-intensity exercises (Peng, Lin, & Crouse,2011).

Kosse et al. (2011) collected and analyzed data before, during, and after the study of nine healthy elderly individuals who played a digital exercise game to perform a balance exercise for six weeks. Although no significant differences were observed, the results were found to increase positively (Kosse, Caljouw, Vuijk, J., & Lamoth, 2011).

Christison and Khan (2012) carried out using eight different exercise-oriented three-dimensional games selected by the researchers on forty-eight children between the ages of eight and sixteen in the research that attempts to gain behavior for a healthy life. As a result of their studies, it was seen that there was a positive change in behavior (Christison & Khan, 2012).

Brox et al. (2011) concluded that exercise games used in a study conducted by three-dimensional games for exercise in terms of their contribution to sociality and physical mobility in elderly individuals did not have any social contribution. Still, it is seen that exercise games contribute to physical movement. The reason for this result is stated as the fact that individuals have prejudices due to their age-related to informatics and not to adopt the concept of socializing with these systems (Brox, Luque, Evertsen, & Hernández, 2011).

In their studies, Demir and Akın (2018) examined the effects of balance training for the static balance development of six-year-old children playing a digital game for exercise by using a balance board in eight weeks. While the data obtained were observed that double-standing balance did not make a significant difference, the single-standing balance made a significant difference. Active video games were seen as an alternative solution for balance exercises for six years old group participants (Demir & Akın, 2018).

Chang, Chen, and Huang (2011) selected two students with disabilities as the study group in Kinect® based on physical therapy and rehabilitation plans. The ages of these students studying in public schools are sixteen and seventeen. The results of this study using a system called Kinerehab have been found to contribute positively to both students' motivations (Chang, Chen, & Huang, 2011).

Geurts (2011) aimed to develop a system to be used in the physical therapy process using existing input devices such as motion detection equipment in his study. Four mini-games, specially prepared for individuals with physical disabilities, have been implemented within this study's scope. The development process took place in eighteen months, with seven field experts. Twenty-one participants with various physical disabilities took part in the application of the developed products. It sheds light on how the applications developed in the research should be carried out step by step in other future studies (Geurts et al., 2011).

Chang et al. (2012) compared the OptiTrack and Kinect® systems in their study to measure the success of various technologies with the use of technology in physical therapy. In the research conducted with the game-based rehabilitation application, the low-budget Kinect® system was found to be as successful as the high-budget OptiTrack. As a result of the study, it was stated that these systems could be used in rehabilitation treatment both in clinics and at home (Chang et al., 2012).

Chang, Han, and Tsai (2013) conducted procedures for treating patients with cerebral palsy using a Kinect®-based system in their study. Two fourteen-year-old students with cerebral palsy attended this study. There are three movements in the application. These are determined as raising the hand, extending the hand forward, and closing the mouth with the hand. As a result of these processes, although the number of tasks which they achieved by both participants was low, there was a definite increase in their motivation for treatment (Chang, Han, & Tsai, 2013).

If we summarize the research results in the scope of the data obtained; while the studies stated that exercise is of great importance for human health, they also mentioned that the activities should be carried out in a correct and controlled manner. In this context, research has conducted using various technologies to gain the habit of exercising and awareness of healthy living. The results obtained using technology generally provided positive benefits to the participants' exercise consciousness and exercise outcomes.

The vast majority of studies using three-dimensional games for a healthy life are directed towards a specially defined disease type. The number of studies conducted to gain awareness of healthy living is less than the studies conducted to treat a particular disease. Since researchers perform the studies in the health sciences in general, ready-made systems in the market are used rather than three-dimensional games suitable for the purpose.

Since most of the applications in the literature are carried out with existing games, the model that will be needed in the design and development processes of specially designed exercise games should be revealed. In this context, game development models and gamification concepts thought to be appropriate should examine.

According to the data obtained in the research on all exercises performed using a three-dimensional game, it was observed that the users' developments need to follow. It should also note that analysis processes and monitoring of these processes are essential as well as measuring devices.

ELEMENTS OF GAMIFICATION

Gamification is defined as the use of techniques in game design in non-game concepts (Kapp, 2012; Marczewski, 2013). The gamification concept, which enables non-game ideas to be realized more interestingly, prioritizes the advantages of responsibility, efficiency, motivation, and behavior change (Marczewski, 2013). Game and gamification concepts have many standard features. Entertainment items in the games are also available in gamification. As in sports, using various technologies or having some limitations is also in the concept of gamification. The idea of gamification, which can be developed with different players and content, also includes the addictive features found in games from time to time (Kim, 2015). The fact that all these elements in the games are also included in the concept of gamification enables the participants to feel the game and adapt to the process more quickly (Yılmaz, 2015). Despite all these, gamification and games are different concepts (Kapp, 2012). Gamification elements hierarchy consists of dynamics, mechanics, and components. (Werbach & Hunter, 2015).

Dynamics

The dynamics that target gaining motivation by using storytelling and social interaction are composed of elements such as limitations, emotions, storytelling, progress, and inter-player relationships (Werbach & Hunter, 2015; Yılmaz, 2015).

•**Storytelling:** The most common method used for sharing information in many cultures is the use of storytelling. The correct adjustment of the story's fiction appeals to the deepest emotions of the listener, while also contributing to remember the story. Using real-world examples in stories increases the attraction and contributes to the success of the results (Kapp, 2013).

•**Relations:** In this process, where player status is defined, the player profiles must analyze correctly, and the relationships between the players must be determined. This process can have a single-user competitive structure and a relationship based on multi-user friendship, competition, or social interactions (Güler & Güler, 2015; Lehdonvirta, 2009).

•**Rules:** In gamification, limiting participants' freedom takes place by rules (Şahin et al., 2017). The application of time restriction in reaching the target of the user can be given as an example (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015).

•**Goals:** Even though there is no winner in the gamification process, as in games, the goals to be reached must be clearly and understandably explained in the orientation processes (Dorling & McCaffery, 2012; Yılmaz, 2015). In a scenario where the goal is to collect ten apples, participant's behavior, which is expected, is to collect apples, and the result is clearly stated as collecting ten apples (Robson et al., 2015).

Mechanics

Mechanics are tools that enable motivation and interest to increase by allowing components that use elements such as luck, reward, and tour. (Werbach & Hunter, 2015; Yılmaz, 2015). Game mechanics luck factor, challenge, contest, team, feedback, reward, resource collection, interaction, rank, winning status, status, etc., contains the components (Kim, 2015; Yılmaz, 2015). These components' ability to develop a game allows categorization as game mechanics (Sezgin, Bozkurt, Yılmaz, & Van Der Linden, 2018).

•**Luck Factor:** Luck or randomness is one of the most difficult mechanics to estimate gamification. Using the dice in the created story can be shown as an example of the use of the luck factor (Sillaots, 2014).

•**Challenge:** This element is a promise made by the player in a nutshell. A goal is set by challenge and is expected to be completed (Yılmaz, 2015). An example of this is to perform the defined tasks alone with the promise given by the player (Gil, Cantador, & Marczewski, 2015).

•**Competition:** The concept of competition, whose success outcomes are defined as a previously described process, is the participants' struggle according to one or more items (Maan, 2013).

•**Team:** It is a mechanic requiring the participants to work together as a team with the feeling of working together in the process of achieving the goals and contains many sociological features (Birant, 2014).

•**Feedback:** Feedback is used to notify participants of the progress or failures in the scenario in which they are located. Although the timing of the feedback varies between studies, the ideal is to provide feedback when needed (Passos, Medeiros, Neto, & Clua, 2011).

•**Source:** Money, food, etc. needed in daily life during the gamification process. By collecting items, it can be ensured that they are used for various purposes in the process. It is a source of gaining that is used in three-dimensional gamification (Yılmaz, 2015).

•**Interactions:** The interactions, which can be defined as the market place in gamification, allow the resources obtained to be traded between the players within the framework of a rule (Utterheim & Sundberg, 2019; Yılmaz, 2015).

•**Sequence:** This means that the participants can interact with a shorter but more frequent period and involve them in the process with a specific sequence or time constraint in certain periods (Göschlberger & Bruck, 2017; Yılmaz, 2015).

•**Winning:** The points that the participants deserve in the process, etc., provide feedback on the progress they have achieved with the items (Bartel & Hagel, 2016).

Components

The components that the end-user can directly interact with are; Achievements, badges, fighting, collections, rewarding, content opening, social graphics, team, winning status, leaderboard, player level, points, tasks, and virtual savings (Karataş, 2014; Yılmaz, 2015).

•**Avatar:** Avatar, which is considered as profile pictures of the players in their environment, allows the individual to internalize himself within the system (Karataş, 2014; Yılmaz, 2015). The fact that players adopt avatars that they can choose or customize according to their wishes from a selection pool increases their interest in the system (Kuramoto, Ishibashi, Yamamoto, & Tsujino, 2013; Light & Pierson, 2014). For example, in their research, Kuramoto et al. (2013) developed a system that allows users to establish their avatars as they stand in public transportation. At the end of the research, it was discussed that the participants preferred to stand to improve their avatars and that their motivation increased during their action (Kuramoto et al., 2013).

•**Rewards:** Gamification is a concept that is fully synchronized with the reward component. The reward component has been used to gain behavior in many areas from past to present. Taking steps to increase intrinsic motivation instead of extrinsic motivation during this component provides more opportunities for behavioral gain. For example, in some hybrid cars, the driver's contribution to nature is shown on the vehicle screen due to brake and gas pressures. Participants changed their way of driving their vehicles over time to contribute to the environment and reach the visual target on the screen (Nicholson, 2015).

•**Score:** The score, which is one of the most classic and most used game mechanics with numerical data, shows the current status of the players (Karataş, 2014; Yılmaz, 2015). The score system directly related to the participant's motivation is also associated with components that indirectly include the leaderboard, level, progress, etc. (Mekler, Brühlmann, Opwis, & Tuch, 2013). With the scores used in gamification, the participants can see their current status statistically, and at the same time, they can receive badges, avatars, etc., with these scores. They can also access other gamification components (Light & Pierson, 2014). The number of likes, number of followers, etc., in social networks can be given as an example of the use of score in-game mechanics (Yılmaz, 2015).

•**Badges:** The badges that are used as an alternative to rewards and goals and obtained according to the tasks completed by the participants are images that symbolize the success of the players. Badges, one of the most used topics in gamification research, are visible in the participants' systems according to the setup and goals of the process (Hamari, 2017).

•**Leadership:** One of the most used components in games and gamification, the leadership chart is used within the scope of design principles such as competition and cooperation, and being visible in the social environment. The leadership table, which is a visual representation of the users' developments according to the badges and scores obtained by the users, reflects the performances of the participants according to the other users (Dicheva, Dichev, Agre, & Angelova, 2015). It can contribute to motivation when the leadership table is constructed correctly, and when added randomly, it can turn into a structure that can be demotivating to the users. According to the setup of the system, a leaderboard can be created between friends and/or all users. During the preparation of the leadership table, all possibilities should be examined. They should be prevented from being demotivating to by providing feedback to the user according to their situation (Yılmaz, 2015).

•**Level and Progress:** One of the experiences that users experience in their fiction is that they are directed towards targets that will push their existing abilities more and depending on their level of development and see their current status in the process (Birant, 2014).

•**Tasks:** The tasks defined as the goals that the participants have to complete within the gamification fiction can contribute to the participants' motivation when presented to the participants in a transparent manner. A clear introduction of the tasks, the presentation of the results in case of completion of the objectives, and the importance of the steps required to achieve the goal should be used to ensure transparency (Sailer, Hense, Mandl, & Klevers, 2014).

GAME DEVELOPMENT MODELS

The input-process-output game model and experiential game model, which are thought to be used in the game development process for exercise, are examined under this title.

Input-Process-Output Game Model

The model Garris, Ahlers, and Driskell (2002) developed for gaming learning have targets for providing permanence in the motivation of the users and creating learning outcomes by supporting the game and learning elements with feedback to user decisions

and behaviors within the game cycle. This model does not imply that all participants learn the same or have the same learning outcomes due to the individual differences of the users in the game cycle. Still, it has been emphasized that active participation and the presence of learning supporting elements can create a productive learning environment (Garris, Ahlers & Driskell, 2002). The Input-Process-Output game model is located in Figure 4.

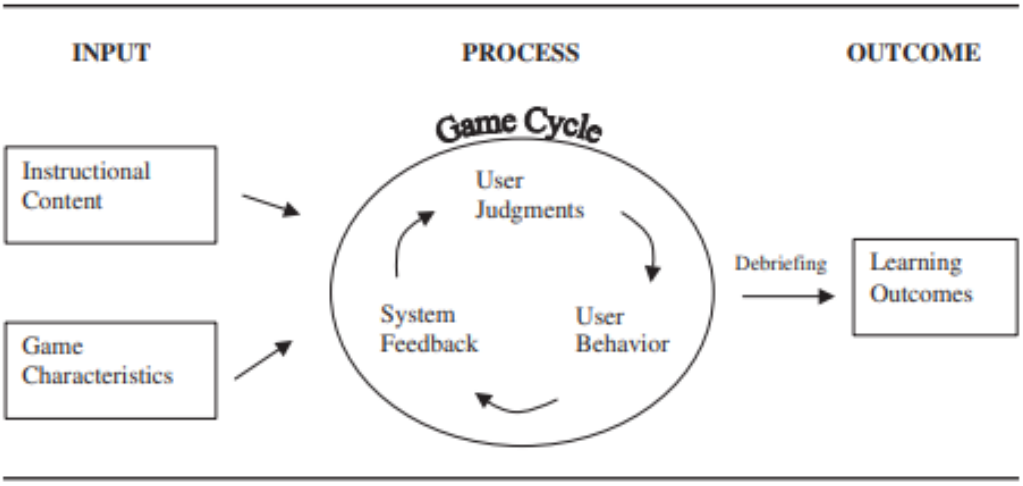

Figure 4. Input-Process-Output Game Model

Experiential Game Model

This model, which consists of a game and design cycle, can be used to develop all types of games, especially educational games. The model emphasizes the importance of loops in the game designs, such as difficulties that match the player's skill level, clearly stated goals, clear feedback, focused attention usability, control over the game. Direct experiences in the game are explained through cyclical processes. This system, which is compared to the human heart and vascular structure as a working principle, provides the opportunity to increase the participants' continuity in the games with its easy playability, clear goals, and definitive feedback (Kiili, 2005). The Experiential game model is located in Figure 5.

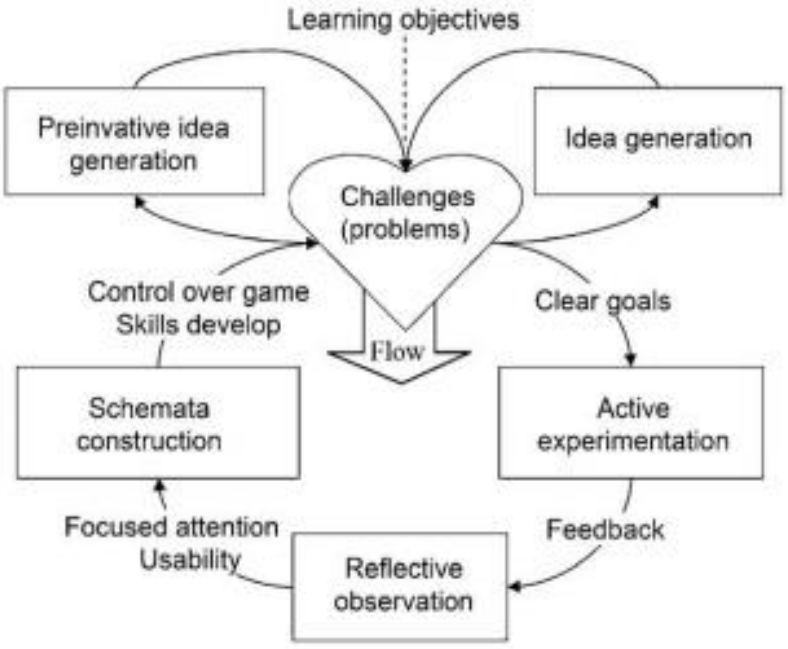

Figure 5. Experiential Game Model

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DEVELOPMENT A MODEL OF THREE-DIMENSIONAL GAMES USED IN EXERCISE PROCESSES

When the current data are examined, individuals need to take all their precautions in the initial protection period, which is one of the three periods called the pre-disease period to gain healthy living behaviors (Bilir, 2007).

The researches emphasized that the most active life among individuals, which is one of the needs of this behavior, is the most important. Although this situation is not how the individuals participating in the research think, in terms of its indirect benefits, it can be accepted as correct. Although experts state that different situations are depending on the physical fitness of individuals, they generally emphasize that at least thirty minutes of physical activity per day have significant benefits (Akyol, Bilgiç, et al., 2008; Blair et al., 2004; Fulton et al., 2004). In this context, taking steps to prevent sedentary life will contribute positively to the health of individuals (İlhan, 2010).

Performing exercises regularly and adequately will help individuals achieve positive results directly and indirectly. Considering the physical fitness of individuals in determining the goal positively affects the measurement of success and the validity of the exercise program (Akyol, Bilgiç, et al., 2008). Creating special exercise training programs for users and providing expert support is one of the crucial factors in achieving the purpose of the designed exercise as well as the sub-criteria in the evaluation of the organizations giving exercise services (Akgül, Sarol, & Gürbüz, 2009; Aydin & Yaşartürk, 2017). It is necessary to get expert support in creating exercise programs suitable for individuals (Baltacı & Düzgün, 2008). Exercises that are not designed by the purpose can cause a feeling of failure due to the pressure on individuals and can lead to loss of motivation and adverse effects in the habit acquisition process (Aydin & Yaşartürk, 2017; Baltacı, 2008).

Even if it is planned following the purpose, the absence of motivating elements in the exercises may cause the exercise habit to be negatively affected (Fried et al., 2004; Tai, Gould, & Iliffe, 1997). Some of the items that motivate the participants in the exercise processes are gamification items such as awards, badges, points (Tóth & Lógó, 2018). The devices used in the measurement of the exercises and the follow-up of the individuals' development contribute to the motivation of the participants in addition to their intended use (Bradley et al., 2015). Consider all data about the problem, exercise systems using game and gamification have been examined in the research, it has been observed that using these systems with objective measurement tools contributes to achieving positive results (Sinclair et al., 2007). In this case, because individuals do not reach their goals due to the inability to offer adaptable or customizable exercise programs according to the physical fitness of individuals, the systems which digitalized for exercise used with games and gamification can cause motivation decline.

In addition to all these items, there is no difference between the exercises performed in the home environment and the group exercises in terms of the participants' commitment to the exercise (King, Haskell, Taylor, Kraemer, & DeBusk, 1991). Since similar games show the same results in the games developed for exercise, it may allow these systems to reach more participants in the home environment (Mat Rosly, Mat Rosly, Davis Oam, Husain, & Hasnan, 2017; van Diest, 2016).

According to the data obtained in this context, the need to develop the system, which has the following features, has emerged:

- Creating user-specific exercise training programs
- Carrying game and gamification elements
- Providing expert support in determining exercise games
- Has tools rich in measuring and evaluating physical activities
- Giving feedback about short and long term user performance
- Can be used in the home environment

There are some similarities when the game development models which are chosen by researchers compared with the needs of three-dimensional games for exercise. At the same time, there are some missing items on that game development models.

When the input-process-output and experiential game models are analyzed, it aimed that to find the game elements, create motivation, and ensure continuity (Garris, Ahlers & Driskell, 2002; Kiili, 2005). These features are similar to the characteristic features of the mentioned models in terms of carrying the game elements to be used in the research and giving feedback on user performance.

It reported that providing technical support to the user in the developed games may produce more effective results (Garris, Ahlers & Driskell, 2002). This item has similarities to the ability to provide expert support in determining exercise games. And adjusting the games for user goals is similar to the feature of creating user-specific exercise training programs in the experiential game model (Kiili, 2005).

Besides other items that are not included in the existing models but are needed in the model to be used in the development process are the tools that are rich in measuring and evaluating physical activities and can be used in the home environment. Use in the home environment is created by the nature of digital games. The model designed by researchers will be ready to be used using objective measurement tools as measuring physical activities and evaluating.

CONCLUSION

Three-dimensional games for exercise, which developed to provide healthy living awareness, should have some features. These are: offering individuals the necessary activities for a healthy life under the supervision of a specialist, in a customizable and traceable way, and includes practices that can motivate individuals to keep them active in the system. The finding of these features plays a significant role in gaining awareness of healthy living (Göbel et al., 2010). Three-dimensional games are generally used in health education and used effectively in the regression of many diseases and even in preventing diseases (Wiemeyer, 2010). In applications developed on the subject of health, it is needed to be designed especially for monitoring long-term activities (Larsen, Schou, Lund, & Langberg, 2013). The fact that the majority of three-dimensional games for exercise in the literature are ready-made games and the numerical scarcity of research on the elements that should be considered in the development of three-dimensional games for exercise made the inevitability of this research.

When the game development models that can use in the three-dimensional game development process are examined, there was no solution has been found to meet the needs (Garris, Ahlers & Driskell, 2002; Kiili, 2005). Consequently, a new development model has been created by referencing the related features of input-process-output and experiential game models for use in exercise games. This research will also contribute to the emergence of the model to be followed in the development of three-dimensional games for exercise.

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