# Design and Development of a Gamified Tutorial for iVR Serious Games

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**Abstract:** Serious games, including immersive Virtual Reality (iVR) experiences, can be challenging for players due to their unfamiliar control systems and mechanics. This study focuses on designing a gamified tutorial for iVR serious games that not only teaches iVR interactions but also enhances user enjoyment and engagement. The tutorial consists of progressively challenging mini-games that adapt to the user's performance. Tips and recommendations are provided through a robot avatar if users struggle or make mistakes. An optional narrative is included to enhance user engagement, but it is not mandatory for the iVR experience. Gamification elements, such as point collection and progress updates, are incorporated into the tutorial. It can be played independently or as an introduction to iVR serious games. The goal is to use gamification principles to maintain user engagement and flow while enhancing the learning experience in the virtual world.

**Keywords:** Tutorial, Virtual reality, Gamification, Serious games, Video games

## 1. Introduction

Since their inception, video games have gained popularity as a complementary tool for educators to enhance their teaching. Several studies have supported the notion that video games can facilitate learning and increase student engagement with the lessons (Hamari *et al.*, 2016). However, the mental processes involved in learning through video games are complex, and designers must consider various factors when creating both the game and the learning experience. Recent literature suggests that the novelty of a game, including surprising events, is what engages players (Huang, Jasin and Manchanda, 2019). Introducing a new tool into a classroom's routine can excite and intrigue students, but this novelty effect can have negative effects on the assessment of the learning experience's effectiveness (Huang, 2020). To address this, tutorials have been a part of video games since their early days, and their purpose is to familiarize users with the game's environment, mechanics, and controls. Tutorials can take various forms, such as physical instruction manuals, special levels, or pop-ups (White, 2014). However, not all tutorials are suitable for all players, as different games require different types of tutorials based on the player's skill and experience level. Tutorials can be implemented in various forms, such as audio guides, pop-ups, or non-playable characters (NPCs), but designers must carefully consider the game's type, player type, context, time, and instructions to optimize the learning experience.

In the realm of video games, the use of immersive Virtual Reality (iVR) technology is gaining popularity, as are serious games. iVR allows users to enter a virtual environment where interactions feel more natural compared to using a traditional console controller. Additionally, iVR has been found to enhance learning, as some studies have demonstrated (Checa, Miguel-Alonso and Bustillo, 2021). However, compared to non-iVR video games, the novelty effect is more likely to occur in iVR due to its newness and unfamiliarity among players. Thus, the inclusion of a tutorial is of paramount importance, as previously examined in research (Miguel-Alonso *et al.*, 2023). Tutorials not only teach users how to utilize the controllers, interact with objects, and comprehend the mechanics of the iVR video game, but also enable users to become acquainted with the iVR environment.

This study is focused on the design and development of a gamified tutorial for an iVR serious game. Previous research has highlighted the positive effects of gamification on skill acquisition, creativity, critical thinking (Najjar and Salhab, 2022), motivation, performance (Nor, Sunar and Kapi, 2020), learning outcomes (Alptekin and Temmen, 2020), and training results (Vargas-Macías, Rodríguez-Hernández and Sánchez-Saenz, 2020). In order to include gamification in the tutorial, various aspects must be considered, as outlined Trujillo-Espinoza *et al.*'s research (2021), including intuition, clarity, familiarization, and the use of interfaces to improve training performance.

However, the application of gamification in iVR tutorials has not been extensively researched (Howard, Gutworth and Jacobs, 2021). The primary goal of the proposed iVR gamified tutorial is to teach users how to

interact in the iVR environment and familiarize them with its workings. Moreover, the tutorial aims to be general-purpose to maximize its utility across various applications. To keep the tutorial engaging and prevent boredom, a storyline is incorporated (Kern *et al.*, 2019): users are guided through the tutorial by a robot that must escape a circus scenario. To accomplish this, users must complete various levels consisting of mini-games, while simultaneously learning the interactions and becoming familiar with the environment. The levels are increasingly difficult to enhance motivation (Škola, Tinková and Liarokapis, 2019), and they can be replayed as desired, but are not mandatory to achieve the robot's freedom and progress to the next application. The gamification system rewards or punishes users based on their success or failure, with points awarded or deducted, and special rewards granted for certain accomplishments. To improve skill acquisition, knowledge acquisition, and performance outcomes, various theories and literature are applied, including the Cognitive Theory of Multimedia Learning (Mayer, 2014), Gamified Learning Theory (Landers, 2014), Flow Theory (Csikszentmihalyi, 1991), and the book "Learn to Play: Designing Tutorials for Video Games" by White (2014).

## 2. Related Work

Several studies have emphasized the importance of tutorials for video games. Cao and Liu (2022) highlighted the significance of tutorials in teaching the mechanics of video games and increasing player engagement. Similarly, Shannon *et al.* (2013) demonstrated that tutorials in serious games optimize performance and knowledge gain and emphasized the need to properly design tutorials for serious games. Also, White (2014) contributed to this idea, adding that tutorials should be integrated into the storyline. To accomplish this, White recommended using minimal visual instructions accompanied by sound cues that complement the visuals. Both should be presented at the appropriate time and provide clear information. However, excessive guidance, redundant information, and presenting information at inappropriate times are not advisable.

In addition, White emphasized the significance of motivation in learning complex actions to avoid boredom. To enhance motivation, he explained the Operant Conditioning, which includes two effective methods of motivation through immediate feedback: providing positive reinforcements and removing constraints as rewards. Furthermore, the difficulty level should increase with the player's exposure time to the video game to maintain high motivation and help them acquire skills and experience. This will also increase their interest, leading to longer gameplay. Therefore, unnecessary repetitions in instructions should be avoided as they may decrease the sense of learning. White explained three ways of presenting instructions:

Cognitive apprenticeship, where a master model demonstrates how to perform an action as instructed to the player.

Just-in-time instruction, where an instruction appears when the player is frustrated and needs help.

Instructional scaffolding, where the player's skills and performance are continuously assessed, and instructions are provided as needed, particularly for advanced players who may not require much guidance.

Learning design principles were analyzed and explained by White in the field of tutorials. Firstly, he explained the way to achieve the same level of skills among all players. The principles considered to achieve this objective in the proposed iVR gamified tutorial are reducing complex mechanics, allowing skilled players to move as quickly as possible, and supporting learning by providing immediate feedback. Secondly, White emphasized that success should always be rewarded, and punishment given rapidly. For the proposed tutorial, these principles are applied by rewarding players immediately (and generously) even for their epic actions. In addition, the cognitive theory of multimedia learning established by Mayer (2014) was also followed to improve learning and avoid distraction. The most relevant principles for the design of the proposed iVR tutorial are: multimedia to combine visual and audio cues; coherence and redundancy to avoid saturation and distraction; segmenting to present tasks as simpler; contiguity to improve understanding by presenting information through close sources.

In the context of serious games for education, Bahrin, Sunar and Azman (2022) distinguished between gamification and game-based learning, emphasizing that serious games simulate real-life situations in which players learn something. Also, they proposed including the Gamified Learning Theory and the Flow Theory to enhance learning outcomes. In their research, Landers, Armstrong and Collmus (2017) explained the Gamified Learning Theory and its two ways in which gamification affects learning. The first is as a mediator, where behavior changes induced by gamification directly impact learning outcomes. The second is as a moderator, where gamification modifies learners' mood and improves learning efficiency. Additionally, they suggested that gamification should not hinder learning, but instead should be felt as an option and comply with the game's rules. In relation to learning, it is considered the state of flow, which not only requires concentration,

but also the user to feel interested and enjoy the iVR experience. Furthermore, flow affects learning outcomes. According to Csikszentmihalyi's Flow Theory (1991), learning is composed of three channels: boredom, flow, and frustration. When skill and challenge are in balance, the learner is in the flow state, which is the optimum one for learning. In contrast, when skill is too high, boredom occurs, and when the skill is not enough to overcome the challenge, the learner will be in a frustration state. The objective of the iVR gamified tutorial is to maintain the learner in the flow state by applying and adapting its dimensions. These are: presenting clear goals to help avoid distraction; giving immediate feedback to increase confident and improve learning and performance outcomes; skill-challenge equilibrium to avoid boredom and frustration; sense of control to increase confidence; action-awareness to become the player involved in the game; high concentration to help avoid distraction; loss of self-consciousness to increase the involvement; rewarding activity to increase motivation; temporal distortion to increase involvement.

## 3. Design and Development

For the design of the proposed iVR gamified tutorial, the previously explained background research was utilized. As a first step, the Gamified Learning Theory was considered to provide players with freedom and to give meaning to their actions. Additionally, the tutorial is not limited by a specific objective, allowing for players to surpass it. As the tutorial is an iVR experience, interactions were designed to be as natural as possible, resembling interactions that occur in the real world.

In the design of the proposed iVR gamified tutorial, Flow Theory was applied by considering the three dimensions that are most relevant for tutorials. Firstly, clear goals were established as one of the main objectives of the tutorial, as having a clear task reduces distraction and frustration for users. Secondly, immediate feedback was provided to the players in the form of rewards for successes or failures, which enhances their knowledge gains. Lastly, the skill-challenge equilibrium was considered by proposing tasks that increase in difficulty and can be repeated as many times as the user wishes to maintain engagement and motivation while facilitating learning and skill acquisition.

Finally, as proposed by White, the iVR tutorial is not a separate level, but rather a series of mini-games that allow for exploratory learning on how to interact with objects and the environment. However, for skilled players, instructions are kept to a minimum, adapting to the learning pace of individual users. To achieve this, the tutorial combines just-in-time instructions when the player is frustrated or unsure of what to do, and instructional scaffolding to eliminate unnecessary instructions as the player progresses. Additionally, cognitive apprenticeship is included to optimize learning. The tutorial is designed with easy-to-understand interactions that allow players to learn at their own pace and achieve the same level of skill. Immediate feedback is provided not only for success, but also for failure and exceptional performances. Finally, dynamism is incorporated to adjust the complexity of the tutorial to the individual player.

Based on the literature review, the proposed iVR tutorial is situated in a circus environment, as it is shown in Figure 1. This location was chosen to convey to users the idea of a fun and playful activity. The circus is a familiar and safe setting, as it is enclosed and has predefined rules, which are conveyed through the tutorial's appearance, such as calming colors and rounded forms. Thus, users will know from their first contact that the activities will be fun and not stressful. The circus is designed with a central circular area and stands to close the stage, which limits the user's movements and reduces production time and costs. To enhance the environment and prevent the feeling of emptiness, certain items are included in the environment, but user interaction is not permitted to avoid errors. The tutorial begins by allowing users to freely familiarize themselves with the environment, and they can start playing when they are ready. The main purpose of this non-interactive introductory level is to enable users to experiment with the iVR controllers, become comfortable with them, and visually explore the space. If users take too long to start playing, pop-ups will appear to provide tips on what to do.

**Figure 1: Virtual Circus scenario during the development phase**

In addition, users can access more information by accessing the menu. The menu screen includes the controllers showing the function of each button, which is considered by White as an appropriate way of implementing a tutorial. This strategy of explaining the possible interactions does not interfere with advanced users, as they do not need this information. Additionally, it complies with Mayer's multimedia principle, pre-training principle, and coherence principle. If users do not know what to do, they may randomly press buttons hoping to succeed and continue playing. At a certain point, they will access the menu and discover tips on the controllers that may be helpful to them. The rest of the interface appears when users take too long to perform a specific task in which they are involved. A pop-up appears, giving them some tips according to the just-in-time instructions explained by White. Also, as a first contact with the task, a robot avatar shows the users how to perform it, following the cognitive apprenticeship method also explained by White. Furthermore, the instructions disappear as users progress, and if they do not know how to continue at some point, tips appear as pop-ups. These tips shown as pop-ups follow Mayer's theory by displaying information at the moment when needed (contiguity principle), avoiding repetition of information (redundancy principle), and having a simple design to avoid distractions (coherence principle), as it is shown in Figure 2.

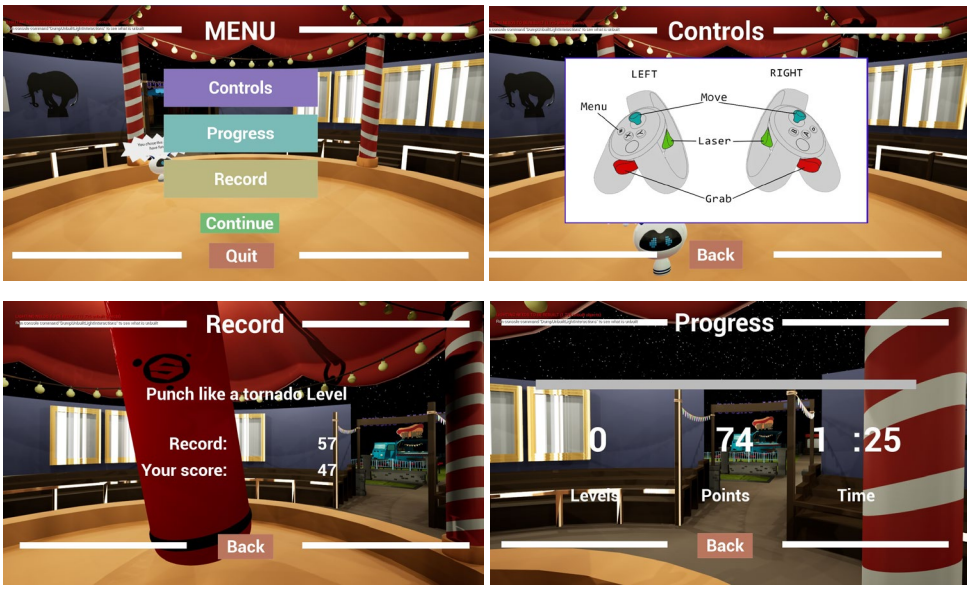


**Figure 2: Pause Menu, controls, record, and progress screens**

The levels of the iVR tutorial are situated in the circus scenario and consist of games or objects that are easily recognizable. These levels involve basic iVR interactions, and the robot avatar provides instructions and allows the user to choose which level to play. The difficulty level increases gradually, striking a balance between challenge and skill, and adapts to the user's level of proficiency (segmenting principle of Mayer's theory). Moreover, users can repeat levels as many times as they like. A reward system and feedback mechanism are in place throughout gameplay, with users earning points for success and losing them for failure. If users

experience repeated failures, pop-ups with tips or the robot will appear to offer advice on how to improve. The system is designed to be simple, as recommended by Chittaro and Buttussi (2019), and does not require further complexity. The levels and interactions proposed in the iVR gamified tutorial are as follows (see Figure 3):

Introduction: This initial part allows users to explore the environment and get familiar with the virtual world. A magic cabin will appear to insert the ticket of the chosen level to start.

Strike the Toys: In this level, users will learn and practice the interaction of grabbing and throwing objects. Users will be allowed to throw balls and strike toys that are positioned at different heights and angles. More points will be awarded for striking the more difficult toys, and users will lose points if they fail to gain any points.

Punch Like a Tornado: Users have to punch a boxing bag as fast as possible within a given time frame. The more hits they get, the more points they earn. The best score among users is recorded and they can surpass it and being rewarded with new objects to punch. This level helps users get familiar with the available space for playing and interacting with the environment.

Slot-Road: In this level, the user has to master the grab interaction by pressing the button of the controller to make a car move and not pressing the button or almost not pressing it to take the curves. The user has to complete the whole laps perfectly to gain points.

Dress the Potato Up: Users will be rewarded with points and the ability to create special effects for the potato character if they dress it up completely by attaching a piece of clothing of each type. This level helps users master their abilities of grabbing and attaching items.

**Figure 3: Levels of Virtual Circus: Strike the Toys, Punch Like a Tornado, Slot-Road, and Dress the Potato Up**

The techniques employed to indicate players' progress may appear redundant, but this repetition contributes to the engagement of the experience, as evidenced by Krishnamurthy *et al.*'s research (2022). These techniques consist of displaying earned or deducted points and a progress bar indicating the total points required to free the robot. To prevent distractions during the experience, both elements are only displayed in the menu. Additionally, the high score record is displayed in the Punch like a tornado and menu screen, as well as the completed levels.

The incorporation of a robot avatar in the proposed iVR gamified tutorial serves to advance the storyline, which centers around the player's objective of accumulating as many points as possible to secure the robot's release from the circus. While it is possible for players to complete the tutorial without finishing the storyline, doing so will prevent the robot from being freed. As White has argued, the tutorial is not obligatory. Instead, it is intended to prepare users for subsequent serious games while also enhancing learning and performance by minimizing the novelty effect, which can impede learning outcomes. The tutorial's storyline establishes a clear objective for the user, which is further broken down into smaller objectives such as gaining a specific number of points and successfully completing the levels. The tutorial's flow is balanced, with the storyline and the

user's skill level matching the proposed challenge. Additionally, the robot provides supplementary information to the users by speaking with them. This aligns with Mayer's theory's redundancy and multimedia principles.

In summary, the design of the proposed iVR gamified tutorial incorporates gamification elements, such as a system of rewards and punishments, a storyline that provides clear objectives and increases engagement, while also achieving the main objective of a tutorial, which is to teach users how to interact with objects and become familiar with the virtual environment.

The development of the proposed iVR tutorial consisted of two stages: modeling and texturizing, and programming. Blender version 3.4 was used for modeling, during which the scenario and interactive objects were created. During the texturizing phase, the modeled elements underwent the application of colors and textures. Some objects lacked proper image textures to save resources on computer memory and to optimize the project's lighting. These objects were those that were placed far from the user's proximity and their visual quality was not critical for user experience. As an example, the steps that surround the scenario were not accessible to users, hence their visual quality was sufficient without impeding the rendering process of the iVR tutorial. Both Blender version 3.3 and Adobe Substance were employed for the creation and application of textures. Finally, the programming phase was implemented using Unreal Engine 5.1. The engine was selected due to its user-friendly node-based programming system, as well as its reputation for creating photorealistic environments and ease of use. These advantages allowed for the programming of the designed interactions while maintaining the established visual quality, and ultimately saved time and development costs.

## 4. Results and Conclusions

The proposed iVR gamified tutorial has been successfully designed and developed based on the principles of the Gamified Learning Theory, Flow Theory, and the Cognitive Theory of Multimedia Learning of Mayer. Furthermore, the design and development process has been carried out in accordance with White's proposal for creating an effective tutorial. The tutorial includes gamification elements, such as a reward and punishment system, a storyline to increase engagement, and clear objectives for the user.

The proposed iVR tutorial is intended for general use and includes basic interactions commonly used in iVR applications. Users can not only learn these interactions but also master them as the difficulty level increases. One of the key features of the tutorial is its incorporation of gamification elements to enhance engagement, performance, and learning outcomes. The application functions as a tutorial and serves as an introduction to serious games or can even be considered an independent iVR game due to its storyline and playability. The mini-games that form the storyline are equivalent to levels, each with unique objectives and rules. Users can gain points or rewards upon success, while failure results in point deduction or other punishments. A robot avatar accompanies the user to provide guidance, adapting to their progress. Tips and recommendations are only provided when users struggle or take too long to complete a task, ensuring that the displayed information is clear, simple, and coherent without being redundant or distracting.

As future lines, artificial intelligence will be integrated into the proposed iVR gamified tutorial. This technology will enable the tutorial to analyze users' performance and adapt to their level of competence, thereby enhancing the training process. Furthermore, users' personalities will be studied prior to the experience in order to tailor the tutorial to their individual learning styles and preferences. This will help to optimize their learning outcomes and ensure that the tutorial is effective for all users. Additionally, avatars will be created for the players to enhance their sense of embodiment and immersion in the virtual environment.

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