



User Experience of Gamified Virtual Reality (VR) in Sport: A Review

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Abstract. Virtual Reality (VR) technology has evolved widely over the previous few years. VR Head Mounted Display (HMD) of various complexities are created for the commercial market and have been used much further than just entertainment games: education, museums, marketing and a broad variety of healthcare problems are now partially covered by VR applications. This paper's primary aim is summarized as follows: 1) to analyze the element of gamification in sports; 2) to analyze the user experience of VR in sports applications; 3) identify aspect of gamified virtual reality recognized by respondents. The input to this assessment is to analyze the aspect of gamification and the component of VR which is not being implemented or which may result in user experience failure.

Keywords: Virtual reality · Gamification · Sports

1 Introduction

Virtual reality (VR) technology has evolved widely over the previous few years. In the past literature, recent advancements in VR can be seen from desktop displays to a virtual reality 360 [1] and Head Mounted Display (HMD). Advanced complexities in HMDs were designed and built for the commercial market and the purpose is far more than just an entertainment game. Education, marketing [2] and a large range of healthcare are now partly covered by VR applications [3]. VR has achieved surprising upgrades and it is also expected to have an enormous influence on daily life. People in everyday life are often attracted by short-term incentives rather than long-term rewards. The attraction to the short-term incentives occasionally drives people to neglect attitude that would be beneficial and subsequently cause individual to lose focus, skip practice, smoke, and overconsume, for instance [4]. In attempting to break these patterns, powerful self-control alone is not enough, and thus people are actively looking for new approach of motivation. In previous literature, gamification is one of the approaches to master and practice self-motivation. Hence, this paper will provide a review as reference [test] and

will describe gamification and VR terms and the relation between both terms which specifically focusing on VR's user experience in sports. This paper's primary aim is summarized as follows: to analyze the gamification's element in general context of sports and secondly, the user experience in VR's sports applications. Then, it aims to identify the aspect of gamified virtual reality experienced by the respondents in VR's sports applications. The outcome of this study will lead to an analysis that identify the elements of gamification in sports and the component of VR, which is not being implemented. Furthermore, existing factors that contribute to poor VR's user experience will also be discovered. The following section will discuss the theory basis, and these are accompanied by the parts of the literature review and followed by gamification and VR's trends. Conclusion and future work will be presented in the final section.

1.1 Theory Foundation

There has been a growing number of literatures on gamification and VR in recent years. Both terms will be explained further with the definition of sports as the direction of this study.

Gamification

Gamification has become a point of conversation across media [5] and one of the possible answers to "Is there a better method of helping people to work hard?". Gamification has been described as the method of user engagement, problem solving, game thinking and game mechanics [6]. Game classification can be described where there is an interactive and objective-oriented interaction in which players can interfere to play with each other's active agents. Examples of game design components typically involve scoring schemes such as points, achievements and showing progress using rates and experience points. In addition, loyalty programs such as frequent flyer points are also implemented as a component of game design for the air travel industry. These component of gamification schemes will enhance a service's use and alter the user's composition as they perform towards external benefits [5]. Reference in [5] indicated seven main aspects in a gamified scheme: points, levels, rankings, badges, challenges or quests, on-board loops and social commitment. In today's popular gamification facilities, sport and fitness are one of the most popular gamification areas and will be the focus of this study.

Virtual Reality (VR)

VR relates to a computer-simulated environment that seeks to cause a feeling of being present in another location mentally or physically [7]. VR technology is primarily presented as an immersive and hierarchical desktop technology that can enhance the perception of reality [8]. VR systems can be categorized into three main categories. There are non-immersive, immersive and semi-immersive dependent on one of the essential aspects of VR [9]. VR was first introduced to sport studies in the 1990s. In sports applications, VR technology can offer a platform for people who may not be able to participate in various sport training courses [10]. One of the VR's main advantages is that digital content sharing can resulted in further representative sampling and comprehensive duplication [11]. Reference in [11] also pointed out that, there are numerous opportunities for fans in the sport industry to discover VR technology material that enables fans to get

closer than ever before in the field. However, limited researches have been done to study how modern VR technologies could improve the practice of applied sport psychology [12].

Sports

Sports typically involve physical activity that refers to any type of body motion that eventually leads towards a rise in one's energy consumption and is conducted in different situations such as work, daily routines and recreation time [13]. In sports and fitness, motivation is the basis of all athletic activity and achievement. Contrarily, it appears to be an area in which individuals find it difficult to get motivated. In recent studies, the alternatives to promote involvement in everyday physical activity have received more attention. VR environments are used to improve imaging practice in sport areas as an approach to a real environment [14]. Since motivation is also considered as the basis of gamification, this study proposes to analyze user experience of gamified VR in sports training setting.

User Experience (UX)

Some UX concepts include the user's qualitative experience of engaging with the product [15]. UX is a dynamic process that is taking place in the real world, reshaping the experience and future growth of the user [16]. With such a comprehensive view of UX, researchers are encouraged to understand a global UX viewpoint that incorporates the role of the product in the users' life [16]. The value of UX varies based on the type of product and its intended uses. Several products are produced without the intention of creating a good customer relationship, while others are planned to provide an excellent UX [16]. In brief, UX involves the responses and reactions of the consumer during the engagement with the product, from the moment they are presented with it to the moment they are used in a certain way.

2 Literature Review

The digital databases for this review were searched and visited on 19 May 2019. Gamification AND ("virtual reality" OR sport fitness) were used as a search string or keyword in the paper selection. Twenty-four papers were found after the preliminary searches to narrow down the selections that align with the goals of this study. In the literature review, the selected papers were examined to investigate the characteristics of gamification in wide context of sports (Sect. 2.1). Moreover, user experience in VR's sport application will be identified (Sect. 2.2), and the combination of gamification and VR in sport applications (Sect. 2.3).

2.1 Gamification in Sport

A complete Gamification Framework called Octalysis (2013) [17] is introduced by Yu-kai Chou. In his perspective, gamification is a model that prioritize on human motivation in the cycle [17]. Essentially, it is a Human-Focused Design. The method is focusing on an octagon design with eight-core drives for each side: epic meaning and calling,

development and accomplishment, creativity and feedback, ownership and possession, social influence and relatedness, scarcity and impatience, unpredictability and curiosity as well as loss and avoidance (Fig. 1) [17]. The Octalysis Framework is structured so that the Core Drives, which concentrate on creative self-expression and social dynamics, are grouped on the right side of the octagon or it termed as Right-Brain Core Drives (Intrinsic). The Core Drives that are most commonly associated with logic, analytical thought, and ownership are measured on the left side of the Octagon and are termed as Left-Brain Core Drives (Extrinsic). Extrinsic motivation is a motivation that originates from a goal, purpose, or reward. The goal does not have to be intriguing or attractive, but due to the goal or reward, people are driven and motivated to accomplish the task.

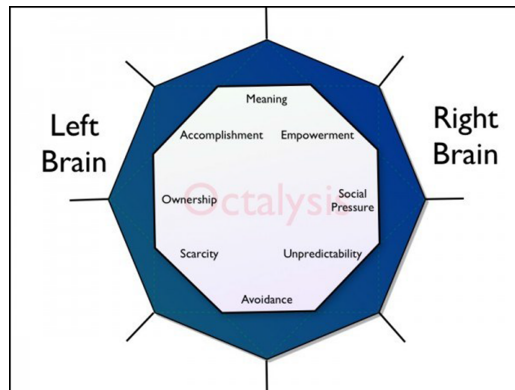


Fig. 1. Left brain vs right brain core drives [17].

Based on the Left Core drives (Extrinsic) in Octalysis framework, gamification elements have been collected and found in the studies into 8 different of gamification elements. Table 1 focused on extrinsic gamification element that are mostly used in sport context. The overall results indicate that among the game elements tested in the study, points [18–21], leaderboard [18, 19, 21, 22] and challenges [18–20, 22] has highest number of effects on the participants. However, based on the results conclude that different people experience gamification in different ways and that personal characteristics such as exercise habits and sports technology attitudes influence the way gamification affects exercise motivation [22].

2.2 Virtual Reality in Sport

As discussed before, VR systems can be divided into three major groups, which are fully immersive, non-immersive and semi-immersive [9]. The immersive VR system is the most expensive and offers the highest level of immersion [9]. This gives the user the impression that they are in the real environments. Non-Immersive VR system, or also defined as Desktop VR system or Window on World system, is the less immersive and cheapest VR system [9]. This enables users to communicate with a 3D environment via a stereo screen monitor and glasses [9]. Semi-immersive VR system, also known as

Table 1. Gamification element

Extrinsic gamification element	Included in the study	#
Points	[18–21]	4
Leaderboards	[18, 19, 21, 22]	4
Achievements/badges	[20, 21]	2
Challenges	[18–20, 22]	4
Avatars	[18]	1
Rewards	[18]	1
Quest	[20]	1
Play mode	[22]	1

hybrid systems [1], generates a high rate of immersion while maintaining the ease of the VR desktop [9]. It has shown that the results are influenced by several features of the VR display and the level of Virtual Reality system. Table 2 provides a description of the study based on user experiences in VR sports. As shown, the use of HMD was fully immersive [23–27] compared to the other VR display. The use of more immersive virtual environment during sport can improved motivation and participants' cycling velocity [21]. Based on the table below, user is able to experience fully immersive environment when they are using HMD as the VR display. HMDs can create the most immersive experiences, that can be achieved through an advanced positional tracking, motion controllers and high frame rates [28]. A bigger display or the combination of more multimodal environmental components will enhance the feeling of immersion in the virtual globe and this may affect efficiency.

Table 2. Level of virtual reality system based on user experience

VR Display	Level of VR system based on user experience		
	Non immersive	Semi immersive	Fully immersive
Cave Automatic Virtual Environment (CAVE)		[25, 28]	
Head Mounted Display (HMD)			[23–27]
Laptop screen	[29, 30]		
Projected	[31, 32]		

2.3 Gamified Virtual Reality in Sport

Gamification of Virtual Reality in sport have been recognized nowadays. To produce a good user experience (UX), the products must be able to fulfill users' requirement or able

to attract the user to engage with the product [16]. Thus, the element of gamification has been used in order to increase the user motivation and to engage user with the systems. Not to forget, the immersive level of the environment is also one of the main points for the user to perceive the system as real environment and to attract them to continuously playing or staying with the system [16]. Table 3 shows the combination from the Table 1 and 2. Immersion is linked to the feeling of being inside a virtual environment [16]. Based on the Table 3 below, it shows that fully immersive have the highest number of studies compared to the other level of VR system based on UX [33–37]. Besides that, adding on challenges [33, 34, 36, 37] and avatars [33–36] as the gamification element has the highest number of studies in fully immersive level of VR system. It is because challenges are essential for the experience, as the user's primary goal is no longer a dull practice, but a challenge within a match that offers greater incentive to complete the activity [33]. Furthermore, the existence of an avatar can be an efficient way of increasing VR exercise concentration [34].

Table 3. Characteristic of gamified VR in sport

Extrinsic gamification element	Level of VR system based on user experience		
	Non immersive	Semi immersive	Fully immersive
Points	[35, 38]	[39, 40]	[33, 36, 37]
Leaderboards	[38, 41]	[40]	
Achievements/badges			[33]
Challenges	[35, 38, 41]	[39]	[33, 34, 36, 37]
Avatars	[38, 41]		[33–36]
Rewards		[40]	[33, 37]
Quest			[33]
Play mode			[34]

3 Trends

3.1 Improvements of Gamification in Design Practice

One appropriate criticism of the present gamified procedures was the narrow viewpoint on game design, leveraging only a limited amount of design components, mostly aimed at acquiring an instant commitment by conveying extrinsic motivations and behavioral reactions [42]. For instance, Chittaro and Buttussi (2018) begin with the issue of developing a serious game for mobile devices to help in the changing of attitudes in aviation security [43]. They realize that, gamification schemes and serious games are always based on real-world scenario simulations that incorporate points, badges and leader boards to benefit the user, while distinct and more complicated design aspects that create enjoyable games are seldom used [43]. The use of components from the arcade game

tradition, such as rigid time limits, avoiding barriers and enemies, and a game framework have been organized around levels of difficulty to assist users in conceptual learning on how to act during the evacuation of aircraft [43].

3.2 Visualization of 3D Scenarios

Several techniques to visualize a virtual or real situation have been introduced in the recent year. Some techniques reflect the real state of fresh developments due to being cited among the frequently adopted techniques as the most interesting by customers. There are Immersive (IV), Nomadic (NV) and Head Mounted Displays (HMD) [44]. A few immersive video techniques that enable navigation in a video have been created [44]. The user can discover the situation in all angles as the video plays. HMDs need to be adapted. Nevertheless, specialists do not suggest the use of HMD at the aged of fifteen and below because of the overly stimulating imagery is hazard to adolescents whose brains are still developing [44].

4 Conclusion and Future Work

This review recognized research studies that explored the use of VR in sport, gamification in sport, and the combination of VR and gamification in sport. A VR based training and involvement scheme has some benefits, such as the ability of athletes to training despite the weather conditions and the ability of individuals to feel the real condition of the environment. Besides, gamification can increase individual motivations where it utilizes a system of goals and accomplishments in boosting the organization's efficiency. Individual satisfaction and performance are increased by implementing gamified elements. In this study, the use of gamification methods to help physical exercise in the immersive VR setting have been studied. Through the outcomes of a user experience, it can prove that gamification components are boosting the pleasure of the user throughout the physical activity and provide a set of rules to encourage the athlete or user to perform better. However, in order to analyze the generality of impacts with VR and gamification in sports, future study is needed. Findings need more varied populations, particularly elements, athletes, kids, and elderly people.

Acknowledgement. Deep appreciation to Universiti Teknologi Malaysia (UTM) for supporting our ongoing research under UTM Transdisciplinary Research Grant (Q.J130000.3509.05G07) that will allow us to identify gamification of VR in sport based on user experience. Based on the analysis of the studies, it will give ideas to boost user motivation and to attract user attention to continuously perform better in sport. Moreover, it able to increase athlete's quality performance in sports field as well as experiencing the real environment without having weather limitation for example.

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