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Measurement of Game Immersion through Subjective Approach

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ABSTRACT

Context. People in recent times are getting engaged more often in playing video games. Few play for enjoyment, few play for stress relaxation and so on. Generally, the degree of involvement of a player with the game is described as game immersion. People when immersed into playing a game doesn't realize that they are getting dissociated with the outside world and are losing track of time.

Objectives. In this research, the main objective is to explore the relationship between the game immersion and game experience using the five factors of game immersion. In addition, the study also involves exploring different methods that can be used to measure game immersion.

Methods. In this research, initially literature review has been conducted to explore the meaning of game immersion and also different methods that can be used to measure it and next user studies in the form an experiment was conducted to measure game immersion. After the experiment was conducted regression analysis was performed on the data obtained from the results to describe the relation between game immersion and game experience.

Results. After the experiment participants were asked to answer the IEQ questionnaire and the answers obtained from the questionnaire are analyzed using regression analysis. An inverse linear regression was observed between game immersion and game experience.

Conclusions. After analyzing the data, from the observed inverse linear regression it is concluded that game immersion levels decrease with the increase in the game experience.

Keywords: Game immersion, Components of game immersion, Counter-Strike: Global offensive, Call of Duty: Black Ops 2, First person shooter games.

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LIST OF ABBREVIATIONS

FPS	First Person Shooter
HCI	Human-Computer Interaction
CS: GO	Counter-Strike: Global Offensive
CoD: BO2	Call of Duty: Black Ops 2
IEQ	Immersive Experience Questionnaire
GexpQ	Game Experience Questionnaire
GengQ	Game Engagement Questionnaire
ITC-SOPI	ITC Sense of Presence Inventory
SPGQ	Social Presence Gaming Questionnaire
CEGE	Core Elements of Gaming Experience

CONTENTS

1 INTRODUCTION

Game immersion is the degree of involvement a player can experience when playing a game[1]. Generally, a high level of game immersion is seen as players living in an alternative game world[2]. Game immersion can be perceived in three levels as mentioned by Brown et al. [1]. They are engagement, engrossment and total immersion. Getting aroused by game interaction is described as engagement which is a low level of immersion. Player connecting emotionally with the characters is described as engrossment which is a medium level of immersion. Total immersion i.e. high level of immersion is the point when the player creates an alternate reality in the gaming world. To design a game that makes player immersed in it is regarded as a major objective by game developers[2]. So, it is important to explore an effective way to measure immersion. This research makes effort to progress in this direction.

According to Jennet et al. [3]immersion can be characterized by five factors, two game factors and three psychological factors. They are cognitive involvement, emotional involvement, real world dissociation and challenge and control offered by the game [3] . Cognitive involvement refers to the focus of the player. Emotional involvement refers to emotional attachment of player to characters in game. Real world distraction refers to the deviation of player's attention from real world. Challenge refers to the level of difficulty of the game. Control refers to level of comfort with the user interface. Measuring these factors can provide an estimate of game immersion [3].

According to literature game immersion could be measured with objective and subjective approaches. The objective approach includes usage of eye tracking device or galvanic skin response device to calculate eye movements and body responses [3]. This information from devices will help calculate immersion. Subjective approach is usage of questionnaires and interviews, post gameplay to extract players' perception and then measure immersion [1] [2]. It is reported that combination of both approaches could result in better measurement of Immersion [3]. This research contributes towards improvement of the subjective measurement of immersion.

The measurement of game immersion is important for advancement of gaming and virtual reality industry. Empirical evidence supporting how digital games are effective and engaging is scarce, which is due to the lack of research attempting to study about the feeling of the players and what they experience through playing these digital games [4]. It is also important for advancement in game addiction research. It has been recognized that playing computer games have some benefits and also sometimes it can lead to some problems such as game addiction, social conflicts and guilty feelings about wastage of time. These things led to the need of measuring game immersion [5].

1.1 Aim and Objectives

Aim: To explore the relation between the players' level of experience and players' subjectively perceived game immersion, as measured by the five factors of game immersion.

Objectives:

- O1: To identify different approaches that are in current use for measuring game immersion which relate to or are based on the five factors of game immersion.

- O2: To measure game immersion using questionnaires based on the five factors of game immersion.
- O3: To explore the relation between the player's level of experience and player's subjectively perceived game immersion.

1.2 Research Questions

The following research questions are formulated in a way to answer the above-mentioned objectives so as to achieve the aim of the thesis.

RQ1: How can game immersion be measured subjectively?

Motivation: The aim of this RQ is to explore different methods that help measure immersion in subjective approach. A literature study will be performed to extract all the various methods used previously to measure game immersion subjectively. This step also helps to gain more understanding about the five factors of game immersion defined by Jennet et al. [3].

RQ2: What is the relation between the experience of gamers and their level of game immersion?

Motivation: The objective of this question is to explore the relation between the gamer's level of game experience and gamer's subjectively perceived game immersion, as measured by the five factors and also to know whether the gamer's level of experience does affect the gamer's subjectively perceived game immersion.

1.3 Thesis Structure

The thesis work is structured into different chapters. Chapter 2 explains about the Background and related work of the thesis topic. Chapter 3 explains about the methods used for this research. Chapter 4 consists of results. Chapter 5 is about analysis of the results. Chapter 6 is conclusion.

2 BACKGROUND AND RELATED WORK

2.1 Human-Computer Interaction (HCI)

Human-computer interaction (HCI) is an area representing more than one branch of knowledge mainly dealing with the theory, design, implementation and evaluation of the ways that humans interact with computer devices [6]. Human-computer interaction (HCI) plays an important role in researching digital games, that are the utmost influential form of computer software and are also relevant in understanding the evolution of user-experience in human-computer interaction [7]. The virtual characters and the virtual environment of digital games generated in the computer have become interactive objects for players, who actively participate in making an interactive cycle with the computer. Hence human-computer interaction has become an important feature of digital games and also the core of many game elements [8].

2.2 Computer games

Computer games have been proven as a popular form of escapism from the reality, as it creates a second reality and make people immerse themselves into it [2]. *"A game is a rule-based system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels emotionally attached to the outcome, and the consequences of the outcome are negotiable"* [9]. To design a computer game, it requires a firm to gather experts, game designers and story tellers. The computer games are perceived by two elements: game-play and environment. Game-play describes about the game, it's rules and scenario and environment of the game is the way it is generated to the player, the physical implementation into graphics and sounds [9]. There are three roles of computer program in a game which are identified by Smed and Hakonen [2]:

- Co-ordinating the game process, e.g. evaluating the rules and upholding the game state [2].
- Depicting the situation, e.g. illustrating a proto-view for the human player and the synthetic view for the synthetic player, including the sensory feedback [2].
- Participating as a synthetic player, e.g. a non-player character [2].

Computer games permits the players to link their perceptions, cognitions and emotions with the first-person actions as it acts as a distinctive medium [10]. Playing computer games is supposed to create a positive experience to the players that is usually associated with the term immersion [9].

2.3 Overview of Immersion

The term immersion usually relates to players, to describe the feeling of being deeply involved into the game [11]. It is very much difficult to define immersion but is usually called as subjective measurement [12]. The concepts related to immersion flow and presence mainly explains about the degree to which the player becomes involved with the game [11] [3].

2.3.1 Flow

Csikszentmihalyi described flow as the “holistic sensation that the people feel when they act with total involvement” [13]. Flow is another concept which has the similarities with immersion [2]. The eight major components that were identified representing flow were: sense of control over one’s actions, concentration on the task at hand, direct/immediate feedback, a challenging activity requiring skill, clear goals, a loss of self-consciousness, an altered sense of time and a merging of action or awareness. It is always not necessary that all the eight components to be present at one time to experience the flow [2]. Brown and Cairns characterized flow as an optimal and extreme state whereas immersion as graded experience, and immersion is called as precondition for flow since flow overlaps with immersion in terms of time distortion [1] [13] [3].

2.3.2 Presence

The computer games often create a virtual world and makes the gamers feel and behave as if they are in to this virtual world. This phenomenon was defined as presence [14]. Lee defined presence as *"a psychological state in which virtual (para-authentic or artificial) objects are experienced as actual objects in either sensory or non-sensory ways"* [15]. Zahorik and Jenison claim that presence should be measured by investigating the relation between perception and action of the player and assessing the degree of involvement between the virtual reality and real world [16]. The difference between presence and immersion is that presence doesn't relate to gaming experience, it is generally viewed as a state of mind, whereas immersion is an experience in time [3].

2.4 Definition of Game Immersion

The term Immersion usually describes the experience of a user in the context of exploration and entertainment. This Immersion is a complex notion which is often related with enjoyment and better outcomes of a game [17]. The immersion being the outcome of good gaming experience, it is often seen as critical to the game enjoyment [3]. The various members related to the game field like gamers, designers and game researchers often mention immersion as an important aspect of interaction and is also considered as a powerful experience of gaming [1]. Few researchers from their findings indicated that the immersion possess these following features [3]:

- Lack of awareness of time.
- Loss of awareness of the real world
- Involvement and sense of being in the task environment.

The term immersion has been described in many ways by various researchers. Menetta and Blade describe the term immersion to the emotional response presented by the virtual environment, while Coomans and Timmermans described immersion as “*a feeling of being deeply engaged where people enter a make-believe world as if it is real*” [18]. McMahan through his study defined immersion by forming a relation between the levels of immersion and the degree of interactivity between player and game-world [19]. According to the study of Brown and Cairns, immersion is used usually to describe the player’s degree of involvement with a game [1]. According to this basis C.Jennett defined five components of game immersion, they are described in the table below [2].

Immersion Factors	Description
Cognitive Involvement (CI)	Strong loadings with items expected to measure effort and attention.
Emotional Involvement (EI)	Strong loadings for items expected to measure affect and suspense.
Real World Dissociation (RWD)	Strong loadings for items expected to lack of awareness of surroundings and mental transportation.
Challenge (Ch)	Strong loadings for items expected to measure how difficult the user found the game.
Control (Con)	Strong loadings for items expected to measure the ease of the use of gaming interface.

Table 1: Factors of game immersion

2.5 Levels of Game Immersion

Brown and Cairns conducted a grounded investigation and identified three levels of game immersion [1].

- **Engagement –** It is the initial level of immersion, where it makes the player invest their time, effort and concentration in learning to play the game and further it makes the player come back again to play the game [20] [21] [2].

- **Engrossment –** It is the second level of immersion, where it makes the player to get attached with the game emotionally and further it makes the game as an important part of the player's life [20] [2].

- **Total Immersion –** According to the study conducted by Brown and Cairns, the term total immersion is represented as another word for presence [1]. This is the highest level of immersion where it makes the player completely involved into the game and also makes him feel as if he is in the game [20] [2].

2.6 Research Gap

The concept of game immersion is in its nascent stage, although attempts been made to measure game immersion yet there isn't any standardized or widely accepted approach [4] [22]. In the literature there have been studies performed focusing on how players are immersed in an immersive task and non-immersive task and also there have been researches done to implement the idea of relating the real world dissociation factor to game immersion [5] [2]. An empirical research was performed to study about the effects of game immersion when a player is dissociated from the real world and also the difference of game immersion between experienced and inexperienced players is measured using the real world dissociation factor [23]. As an extension to the study performed by [23], this research has been carried out in order to measure game immersion using all the five factors of immersion, unlike using only one factor (i.e., RWD factor) [23], and then also to explore the relation of game immersion to the player's level of game experience. According to the gap identified subjective approach is the better way to measure game immersion using all the five factors. The subjective approach is more cost effective than compared to objective approach and the devices used in objective approach are not in a condition to be useful for an experiment setting.

2.7 Contribution

This research mainly contributes to develop a base for measuring game immersion. Measurement of game immersion would be useful for game developers to understand the level of user engagement with the game and tracking game immersion scores during game testing or development could offer some insights about how engaging their games are. Another reason for conducting this study is that it will contribute to the study of the relationship between game interaction and game addiction which is currently on going at BTH.

3 METHODOLOGY

3.1 Literature Review

The literature review is defined as synthesis and analysis of the previously performed research in a particular subject area. It is basically conducted in the initial stage of a research which helps to describe, summarize, evaluate and integrate the content of primary studies. It is performed to know how the research in the selected area has evolved, and this details helps in establishing a new research that advances the previous research [24].

In this research, the literature review is conducted for better understanding about game immersion. It is performed extensively to know about the various methods that exclusively focus on measuring game immersion. This review helps to understand on how to conduct an experiment followed by choosing an appropriate questionnaire to measure game immersion and also to relate the game immersion with gamers' level of experience. The keywords that were used to search the relevant literature were “game immersion”, factors of game immersion, “game immersion and computer games”. The different databases that were used to search the relevant literature were Scopus, Inspec and Google Scholar. The results of the literature review are presented in the results section (section 4).

3.2 Experiment

Researchers usually conduct experiments in order to compare different techniques, methods, working procedures, etc. In some researches, while conducting an experiment the researchers consider user as a variable, they are known user studies in the form of an experiment [25]. Similarly, in this research, the next step after performing literature review was to conduct user studies in the form of an experiment to measure game immersion. The reasons for eliminating other research methods such as surveys and case study are, Surveys are mainly used in market research and are also used in opinion polls and in this research if surveys are used then the questionnaire would be answered in the absence of a gaming controlled environment and the results wouldn’t be accurate. Case study is generally used to explore a single entity within a particular time space and the results we get through case study cannot be generalized [25]. These are the reasons for choosing Experiment as the research method for this thesis.

3.2.1 Selection of Games

The first step is selecting games for the experiment. Existing study showed that playing games socially is more immersive than playing alone [26]. So, the games chosen for this research are first person shooter (FPS) games. FPS games such as Counter-Strike: Global Offensive (CS:GO) and Call of Duty: Black Ops 2 are one of the most popular and successful games and are often been a subject of public interest [27] [28] [29]. The other reason for choosing these two games under the FPS genre are that these two are one of the most top seller games in the Steam website [30]. Another reason is by the fact that these two games are one of the most top seller games, it increases the chance to find participants for the experiment. Steam is a website of Valve Corporation which is one of the most popular online gaming digital distribution platform [31]. The steam website offers more than 4500 digital games serving to more than 100 million users, it also offers players with steam accounts to play public games socially [31].

Description of Counter-Strike: Global Offensive (CS: GO)

Among the six different game modes present in the CS: GO game, the Classic Competitive-Bomb Scenario is chosen for this research, since this is the only game mode that is played professionally [32] [33]. This game mode is played between two teams, one is terrorists and another counter-terrorists and the maximum limit of players is five in each team [32] [33].

Each team has different objectives in the game. The objectives of the terrorists team is to plant a bomb and have it explode and/or to kill all the counter-terrorists. The objectives of the counter-terrorists team are to prevent the bomb from being planted and exploding and/or to kill all the terrorists [32] [33]. The team which completes their objectives before the other team will win the round. When a player loses his life in the game will have to wait for the next round to play again. The inability to respawn encourages the players to play the game more strategically [32] [33].

Description of Call of Duty: Black Ops 2 (CoD:BO2)

This game is developed on a storyline. It has a feature of branching storylines, that is at certain points in the main story missions the player will get different choices to proceed further in the game. The choices of the player could affect the gameplay and even the story. All these features are related to the single player game mode [34]. The CoD:BO2 game also has multiplayer mode or competitive mode in which players get matched with another player who possess similar skill levels and then can play against each other [34].

3.2.2 Participants and Sampling

The sample in this research are the participants who are gamers. These participants were selected from the population by conducting a closed interview [35]. The questions asked in this interview were about the experience of the participants in the particular games that were chosen for the experiment. The measure of game experience is ordinal. Based on the interview the participants were then categorized into four groups, participants with zero experience, 1-6 months of experience, 7-12 months of experience and more than one year of experience [27].

Sampling

The sampling strategy chosen in this research to select the participants is Stratified Convenience sampling as the participants were categorized into groups [36]. The total sample size selected for this research was 80. The total no of participants for CS: GO were 40 and CoD:BO2 were 40. Among these 40 participants for each game, 10 participants were with zero experience, 10 participants were between 1-6 months of experience, 10 participants were between 7-12 months of experience and the remaining 10 participants were having more than one year of experience.

3.2.3 Development of Questionnaire

The questionnaire that was used in this research was developed from the existing literature based on the Immersive Experience Questionnaire (IEQ) [3]. Jennett et al created this IEQ based on the study performed by Brown and Cairns [3]. This questionnaire also provides a general measure of immersive experiences of a wide variety of games [2]. This questionnaire consists of questions related to the all five factors of game immersion that were defined by Jennett et al [3]. There are total of 31 questions present in this questionnaire relating to all

the five factors. For this research, all these 31 questions were used to measure the game immersion. The 5-point Likert scale was used to rate these questions. Among these 31 questions 6 questions were negated as defined by C.Jennett in [3] [2].

Motivation for choosing IEQ

There are various subjective methods present to measure game immersion. A brief explanation of all these methods is provided in the results section (Section 4.1.1.2). This section deals with why IEQ is chosen over other methods.

The main reason for selecting IEQ is that it measures all the five components of game immersion, a mixture of psychological factors (Cognitive Involvement, Real world dissociation and Emotional Involvement) and game factors (Control and Challenge) [2]. This way the IEQ becomes more likely to be selected as it can measure the different elements of game immersion that emerge in different social conditions [11]. Calvillo Gamez et al. created the Core elements of the gaming experience model (CEGE) questionnaire which was not adequate to measure full range of immersive experiences [2]. Erni and Mayra developed the Game Narrative Questionnaire in a way that it was able to measure only one type of immersive experience [10], whereas on the other side the IEQ was developed in way that it will be able to provide general measures of immersive experiences [2]. The Game Experience Questionnaire created by Brockmyer and the EVE-GP questionnaire were associated with only one item related to the immersion according to the questionnaire items [37], while IEQ includes all the factors of the immersion. Hence IEQ is chosen to measure game immersion of the players and relate it to the players' level of game experience.

3.2.4 Procedure

Firstly, all the participants were requested to gather along with their laptops at BTH Karlskrona to take part in the experiment. Each participant was given instructions about the experiment. The basics of the two games were explained to the players who have zero experience in their respective games. The participants who belong to their respective game among the selected two games CS: GO and CoD:BO2 were then randomly divided into groups for playing the games. Each game lasted for about 60 min approximately. After the games were played each participant was given the Immersive Experience Questionnaire (IEQ) and were asked to rate their experience on the 5-point Likert scale. The answers of the questionnaire of both the games were then analyzed using a statistical technique.

3.2.5 Data Analysis

The results obtained through the questionnaire were analyzed using a statistical technique. The statistical technique that is used in this research was Linear regression analysis. The reason for selecting this type of statistical technique is, Regression analysis is a set of techniques and tools used to explore the relation between two variables [38]. According to this research for exploring the relation of game immersion to the player's level of game experience Linear regression analysis would be optimal.

Linear Regression

Linear regression is used to study the linear relationship between one dependent variable and one independent variable. The dependent variable in a linear regression must be continuous and the independent variable can be either continuous or binary or categorical [38]. The linear regression analysis was performed using SPSS 24.0 [39].

- Dependent Variable: In this research game immersion is taken as the dependent variable.

- Independent Variable: In this research, the player's game experience is considered as the independent variable.

- Linear relationship: Linear relationship was observed between the game immersion and player's game experience.

4 RESULTS

4.1 Literature Review

4.1.1 Methods to Measure Game Immersion

The measuring of game immersion can be done either through subjective or objective approaches. Through subjective approach the game immersion can be measured with the help of questionnaires and through objective approach the game immersion can be measured with the help of task completion times and measuring of eye movements [3].

4.1.1.1 Objective Measures for Game Immersion

C.Jennet et al conducted two experiments to measure game immersion through objective approach [3]. The first experiment conducted was to relate the experience of immersion to the objective measure of the time taken to complete the task in another action space. For this the participants were asked to play a control task and a game task. The control task chosen was a tangram task. The time taken to complete the tangram task before and after the game task were recorded and from these results they concluded that a player being increasingly immersed in a game weakens one's ability to re-engage with the real world. The second experiment then conducted was to measure eye movements using eye tracking methodology. This experiment also included an investigation of how eye movements changed over time within both immersive and non-immersive games. The eye movements are of two types Saccades (the fast movements of the eye between fixed points) and Fixations (the intervals between the saccades in which the gaze is held is stationary) [3]. There was also an experiment conducted by Smith and Graham in which they used eye tracking to measure the experience in immersion. From the results they concluded that there was an increase in the game immersion while using the eye tracker [40].

4.1.1.2 Subjective Measures for Game Immersion

C.Jennett et al suggested that game immersion can be measured subjectively through the help of questionnaires [4]. Lennart and Craig conducted an experiment to measure gameplay experience through the help of game experience questionnaire and the different gameplay experiences that were focused in this experiment were boredom, flow and immersion [22]. There are various types of questionnaires that are used to measure different gaming experiences like presence, flow, involvement and immersion [41].

Questionnaires used for measuring Presence in Games

The computer games often create a virtual world and makes the gamers feel and behave as if they are in to this virtual world. This phenomenon was defined as presence. The presence is also considered as one of the most important dimension in game experience which is often linked to the technological advancement [14]. There are various number of presence questionnaires that are used in investigating gaming experiences.

- **ITC Sense of Presence Inventory (ITC-SOPI) –** The ITC Sense of Presence inventory questionnaire is a new state questionnaire which was created by Lessiter et

al to measure the sense of presence. This questionnaire was developed mainly to focus on the users' experiences of media, without taking reference to any objective system parameters. The ITC-SOPI consisted of 44 items addressing the four factors, **Spatial Presence, Engagement, Ecological Validity and Negative Effects** identified by Lessiter et al to evaluate the presence across a range of media, e.g. 2D versus 3D, control versus no control and surround sound versus stereo [42]. Ravaja et al conducted a study to examine the emotional response patterns and sense of presence elicited by video games with different characteristics. For this study they used the ITC-SOPI questionnaire and finally concluded that different video games elicit different emotional response patterns and degrees of presence [43].

- **THE MEC Spatial Presence questionnaire –** This questionnaire consists of various scales that measure the different dimensions of spatial presence. This includes process factors (**Attention allocation**), factors relating to states and actions (**High cognitive involvement and Suspension of disbelief**) and trait factors (**Spatial visual imagery, Absorption and Domain specific interest**). Laarni et al conducted an experiment and measured the spatial presence for each individual factor for different games [44].

- **The Presence questionnaire –** This questionnaire was created with a set of 32 questions to measure the degree to which the individuals experience the presence in virtual world of games. This questionnaire is also used to measure the intensity of the experience based on the factors: **Distraction, sensory, control** and **realism** [45].

Questionnaires used for measuring flow in games

Csikszentmihalyi described flow as the "holistic sensation that the people feel when they act with total involvement" [13]. Flow is another concept which has the similarities with immersion [2]. The eight major components that were identified representing flow were: sense of control over one's actions, concentration on the task at hand, direct/immediate feedback, a challenging activity requiring skill, clear goals, a loss of self-consciousness, an altered sense of time and a merging of action or awareness. It is always not necessary that all the eight components to be present at one time to experience the flow [2]. There are various number of flow questionnaires that are used in investigating gaming experiences.

- **GameFlow Questionnaire** – Sweetser and Wyeth created a model of game enjoyment consisting of eight core elements: **Concentration, Player Skills, Control, Challenge, Feedback, Clear goals, Immersion and Social Interaction.** Considering this model as a basis Sweetser and Wyeth created the GameFlow questionnaire with 35 items to measure enjoyment in games [46].

- **EGameFlow Questionnaire** – The EGameFlow questionnaire is the improved version of the **GameFlow** questionnaire created to measure enjoyment in e-learning games. Fu et al. created this questionnaire with 42 items and used this questionnaire for scale verification of flow in e-learning games. This questionnaire was formed based on these eight factors: **Concentration, Control, Knowledge Management, Challenge, Goal clarity, Immersion, Feedback and Social Interaction** [47]**.**

- **Videogame Experience Sampling Method –** Holt created a questionnaire named as Videogame Experience Sampling Method (VESM) by modifying the Experience Sampling Method questionnaire which was created by

Csikszentmihalyi. This questionnaire consists of questions based on these eight major components: **Hard to Concentrate, Control of actions, Challenge, Skill, Wish Doing Something Else, Something at Stake in the Activity, Depth of consciousness, and Success.** This questionnaire was used in an experiment which was conducted by Holt to measure the differences in flow over time [48].

Questionnaires used for measuring specific aspects of games

There are various other questionnaires that are used in investigating gaming experience that measures specific aspects of games.

- **Immersion in the Narrative Game Questionnaire –** This questionnaire was created with six elements based on the three stages of immersion defined by Brown and Cairns to measure the player immersion in computer game. This questionnaire consists of questions regarding these six factors: **Curiosity, Concentration, Control, Challenge, Comprehension and Empathy** [49]**.**

- **Extended Technology Acceptance Model Questionnaire –** This questionnaire was created based on the Technology Acceptance Model (TAM) to incorporate the social influences and flow experiences as belief-related constructs [2]. This questionnaire was used in the study conducted by Hsu and Lu to prove that attitude, social norms and flow experience accounted 80 percent of game-playing. This questionnaire consists of questions regarding these factors: **Flow Experience, Social norms, Perceived Ease of Use, Perceived Critical Mass, Perceived Usefulness, Attitude and Behavioral Intensions towards online games** [50].

- **Core Elements of the Gaming Experience (CEGE) Model Questionnaire -** Calvillo Gamez et al. developed this CEGE model questionnaire using an iterative process following the psychometric guidance, and was used to measure observable variable to understand the behavior of latent constructs. This questionnaire consisted of 38 questions with 10 scales. The scales that were included are **Enjoyment, frustration, control, puppetry, facilitators, ownership, game-play and environment** [9]**.**

- **Social Presence in Gaming Questionnaire (SPGQ) –** De Kort et al. developed this questionnaire to measure the gamers' involvement with their co-players and also to measure to what extent the gamers were aware of their co-players. This questionnaire consisted of 25 items with three sub-scales: **Empathy, Negative feelings and Behavioral engagement** [51]**.**

- **Computer Apathy and Anxiety Scale (CAAS) –** This questionnaire was basically developed for differentiating behavioral addiction in computing from high engagement of addiction [52]. Charlton and Danforth mostly used the addiction engagement part of CAAS among the two versions, that were created to measure the concepts in gaming [53]. The addiction engagement part of CAAS consisted of 19 items with three scales: **High Engagement, Addiction and Comfort** [52]**.**

Questionnaires which aim to capture full gaming experience.

There are various questionnaires available in the concept of gaming which aim to capture full gaming experience.

- **SCI Model Questionnaire –** The SCI Model for game immersion was developed by Ermi and Mayra. Based on this model the SCI Model questionnaire was developed. This questionnaire was basically developed to measure the components of immersion: **Sensory immersion, Challenge-based immersion and Imaginative Immersion** [10]**.**

- **Game Experience Questionnaire (GexpQ) –** Jsselsteijn et al. created this questionnaire which can assess experiential constructs of **Immersion, Tension, Competence, Flow, Negative effect, Positive effect and Challenge with good reliability** [54]**.**

- **Game Engagement Questionnaire (GengQ) –** Brockmyer et al. created this questionnaire using Classical Test Theory and Rasch rating scale model. This questionnaire provides a psychometrically strong measure of different levels of engagement: **Immersion, Flow, Presence and Absorption** particularly elicited while playing video games. The main difference between the GexpQ and GengQ was GexpQ captures a broad range of players' experience whereas GengQ was primarily concerned with developing a one-dimensional scale [55].

- **EVE-GP Questionnaire –** Takatalo et al. created this questionnaire based on Presence-Involvement-Flow-Framework (PIFF) to understand multi-dimensional user experiences in video games. This questionnaire consisted of 180 items regarding these factors: **Co-presence, Role Engagement, Attention and Valence, Impressiveness, Interest and Importance, Physical Presence, Competence, Challenge and Control, Arousal and Interaction, Enjoyment and Playfulness** [56]**.**

4.2 Experiment

After the experiment was conducted, all the participants were asked to answer the Immersive Experience questionnaire (IEQ). The immersion scores of the participants were calculated by adding all the rating values that were given by the participants based on the Likert scale. The rating that was given for the negated questions were calculated by reversing the actual score of that particular question [57]. The measures of game immersion for both the games are described below.

4.2.1 Measures of Game Immersion

Counter-Strike: Global Offensive

The immersion scores of the players of all the four groups in this particular game were calculated individually. These immersion scores of each individual is represented graphically.

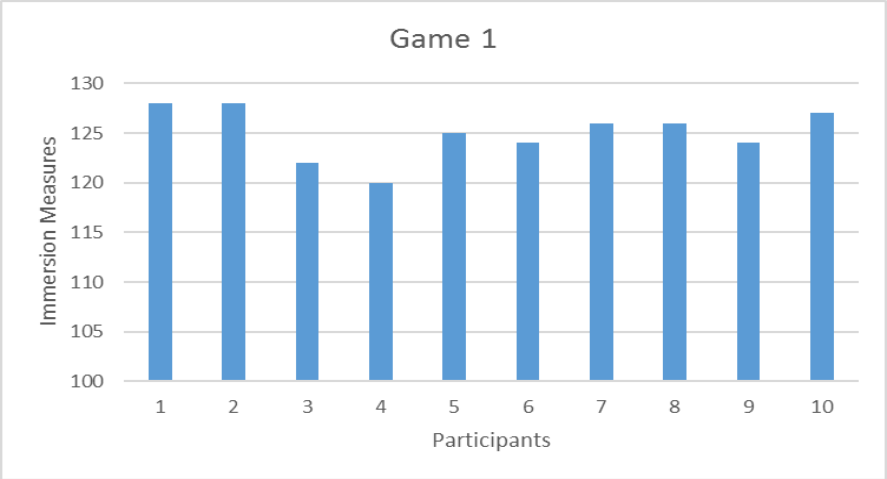

Figure 1: Immersion scores of the players with zero experience in CS: GO

The figure 1 represents the immersion scores of the participants who have zero experience in the CS: GO game. The participants no. 3 and 4 showed lower immersion levels compared to other participants.

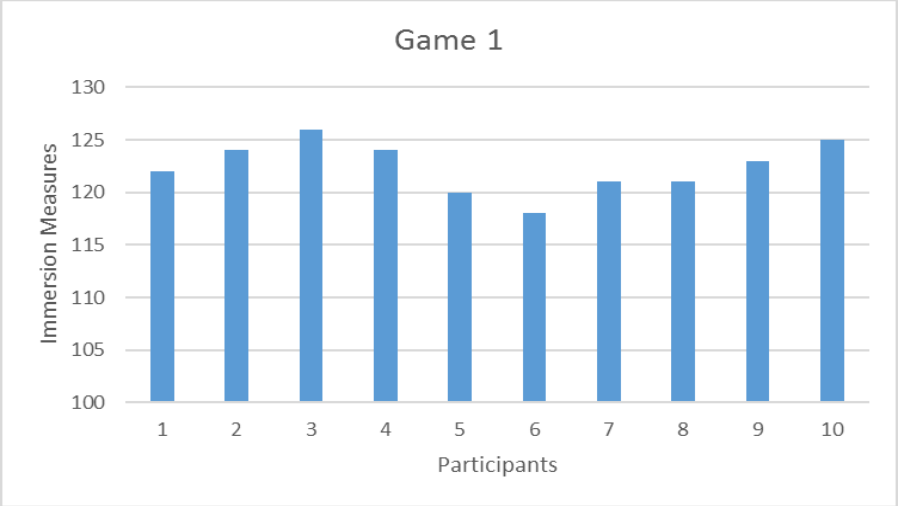

Figure 2: Immersion scores of the players with experience between 1-6 months in CS: GO

The figure 2 represents the immersion scores of the participants who have experience between 1-6 months in the CS: GO game. The participants no. 5 and 6 showed lower immersion levels compared to other participants.

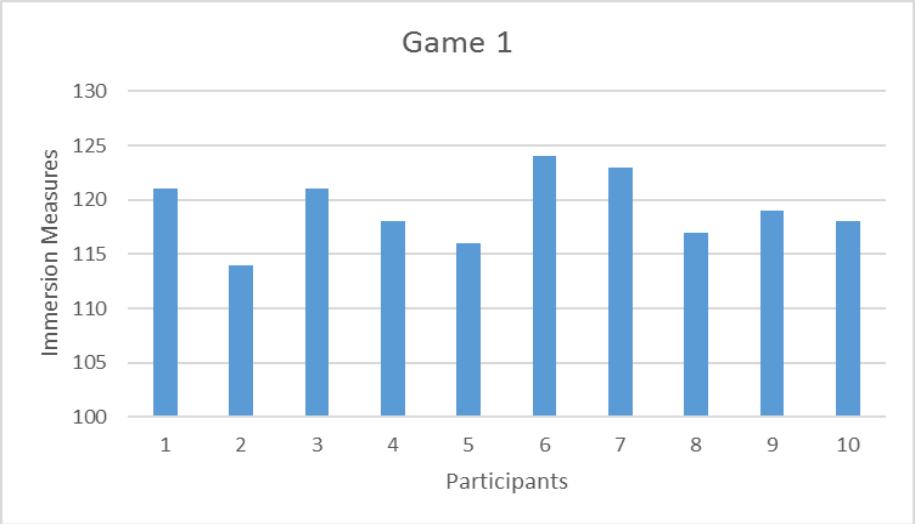

Figure 3: Immersion scores of the players with experience between 7-12 months in CS: GO

The figure 3 represents the immersion scores of the participants who have experience between 7-12 months in the CS: GO game. The participants no. 6 and 7 showed higher immersion levels compared to other participants.

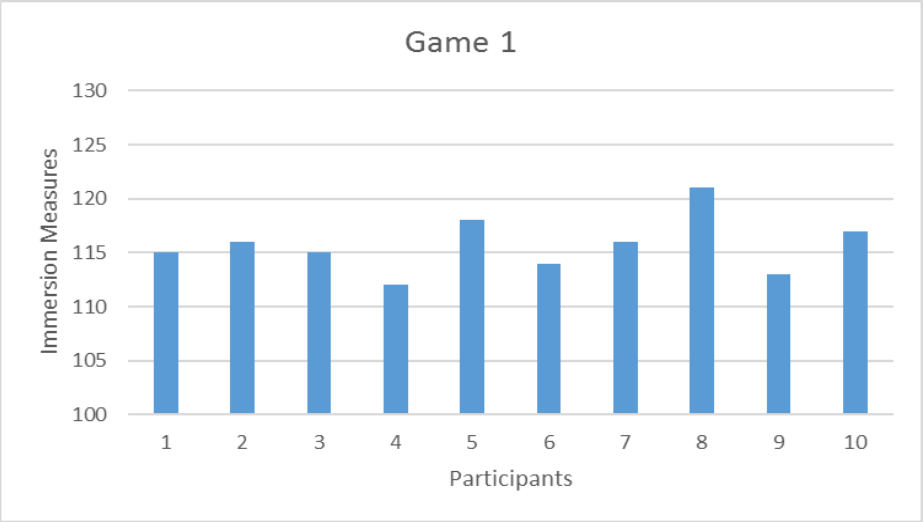

Figure 4: Immersion scores of the players with more than one year of experience in CS:GO

The figure 4 represents the immersion scores of the participants who have more than one year of experience in the CS: GO game. The participants no. 5 and 8 showed higher immersion levels compared to other participants.

Descriptives

	Experience			Statistic	Std. Error
Immersion	Group 1	Mean		125.0000	.81650
		95% Confidence Interval for Mean	Lower Bound	123.1530	
			Upper Bound	126.8470	
		5% Trimmed Mean		125.1111	
		Median		125.5000	
		Variance		6.667	
		Std. Deviation		2.58199	
		Minimum		120.00	
		Maximum		128.00	
		Range		8.00	
		Interquartile Range		3.75	
		Skewness		-.726	.687
		Kurtosis		.021	1.334
	Group 2	Mean		122.4000	.77746
		95% Confidence Interval for Mean	Lower Bound	120.6413	
			Upper Bound	124.1587	
		5% Trimmed Mean		122.4444	
		Median		122.5000	
		Variance		6.044	
		Std. Deviation		2.45855	
		Minimum		118.00	
		Maximum		126.00	
		Range		8.00	
		Interquartile Range		3.50	
		Skewness		-.298	.687
		Kurtosis		-.501	1.334
	Group 3	Mean		119.1000	.99387
		95% Confidence Interval for Mean	Lower Bound	116.8517	
			Upper Bound	121.3483	
		5% Trimmed Mean		119.1111	
		Median		118.5000	
		Variance		9.878	
		Std. Deviation		3.14289	
		Minimum		114.00	
		Maximum		124.00	
		Range		10.00	
		Interquartile Range		4.75	
		Skewness		.073	.687
		Kurtosis		-.704	1.334

	Group 4	Mean		115.7000	.81718
		95% Confidence Interval for Mean	Lower Bound	113.8514	
			Upper Bound	117.5486	
		5% Trimmed Mean		115.6111	
		Median		115.5000	
		Variance		6.678	
		Std. Deviation		2.58414	
		Minimum		112.00	
		Maximum		121.00	
		Range		9.00	
		Interquartile Range		3.50	
		Skewness		.703	.687
		Kurtosis		.894	1.334

Table 2: Mean and Std. Deviation of the four groups of CS: GO game

The table 2 consists values of mean, std. deviation, median, minimum and maximum values of all the four groups in CS: GO game. Here, group 1 represents the participants with zero experience, group 2 represents the participants with 1-6 months of experience, group 3 represents the participants with 7-12 months of experience and group 4 represents the participants with more than one year of experience.

Percentiles

		Experience	Percentiles						
			5	10	25	50	75	90	95
Weighted Average(Definition 1)	Immersion	Group 1	120.0000	120.2000	123.5000	125.5000	127.2500	128.0000	.
		Group 2	118.0000	118.2000	120.7500	122.5000	124.2500	125.9000	.
		Group 3	114.0000	114.2000	116.7500	118.5000	121.5000	123.9000	.
		Group 4	112.0000	112.1000	113.7500	115.5000	117.2500	120.7000	.
Tukey's Hinges	Immersion	Group 1			124.0000	125.5000	127.0000		
		Group 2			121.0000	122.5000	124.0000		
		Group 3			117.0000	118.5000	121.0000		
		Group 4			114.0000	115.5000	117.0000		

Table 3: Percentiles of the four groups of CS: GO game

The table 3 represents the percentiles of the four groups of CS: GO game. Here, group 1 represents the participants with zero experience, group 2 represents the participants with 1-6 months of experience, group 3 represents the participants with 7-12 months of experience and group 4 represents the participants with more than one year of experience.

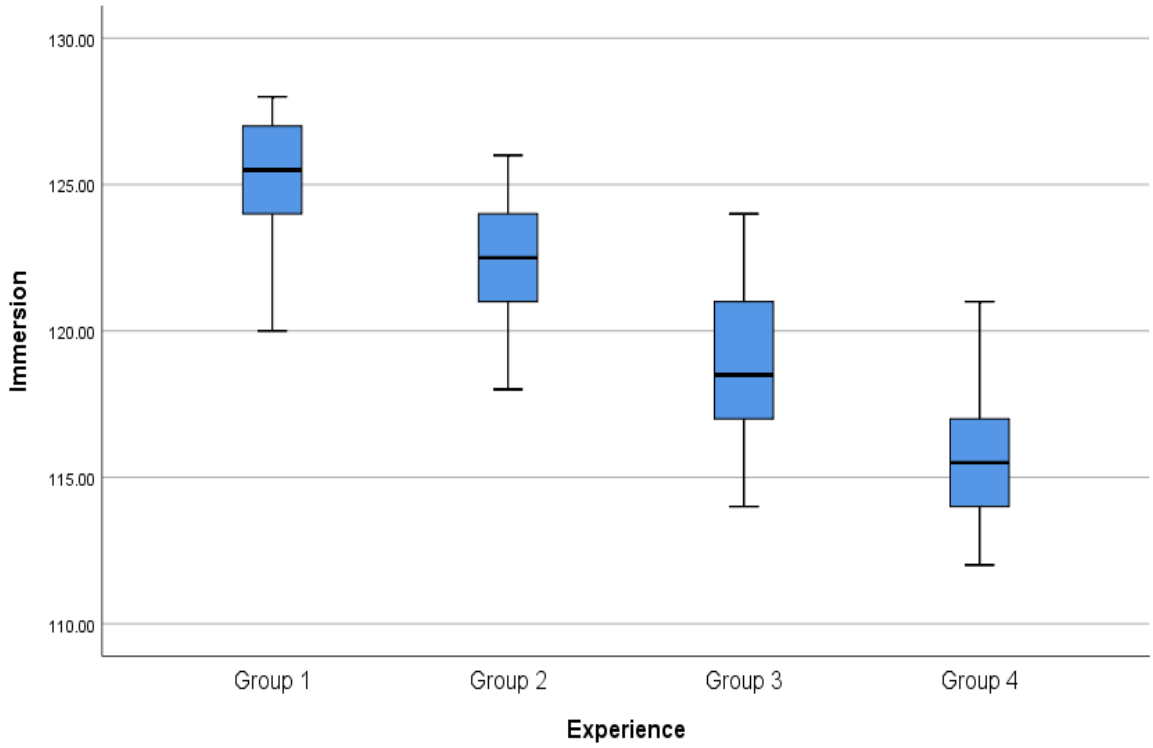

Figure 5: Boxplot representation of CS: GO game

The figure 5 is the boxplot representation of CS: GO game. Here, group 1 represents the participants with zero experience, group 2 represents the participants with 1-6 months of experience, group 3 represents the participants with 7-12 months of experience and group 4 represents the participants with more than one year of experience.

Call of Duty: Black Ops 2

The immersion scores of the players of all the four groups in this particular game were calculated individually. These immersion scores of each individual is represented graphically.

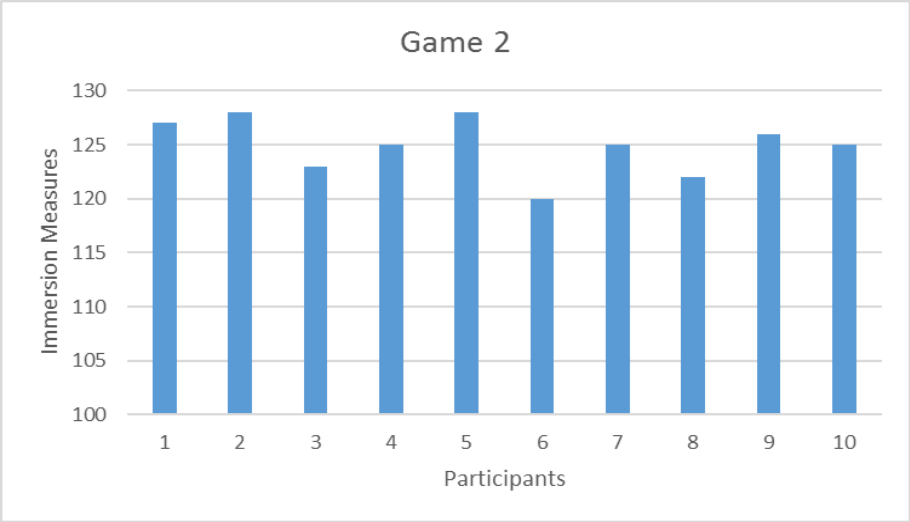

Figure 6: Immersion scores of the players with zero experience in CoD:BO2

The figure 6 represents the immersion scores of the participants who have zero experience in the CoD:BO2 game. The participants no. 6 and 8 showed lower immersion levels compared to other participants.

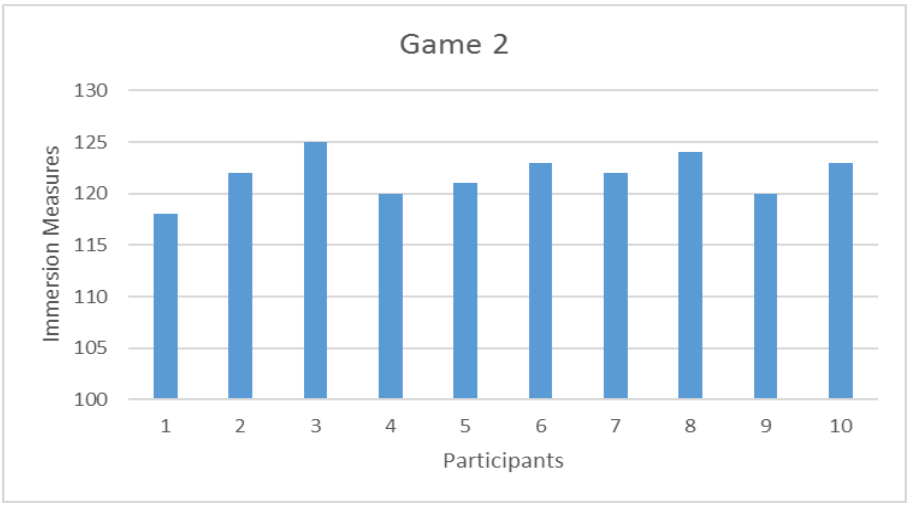

Figure 7: Immersion scores of the players with experience between 1-6 months in CoD:BO2

The figure 7 represents the immersion scores of the participants who have experience between 1-6 months in the CoD:BO2 game. The participants no. 1, 4 and 9 showed lower immersion levels compared to other participants.

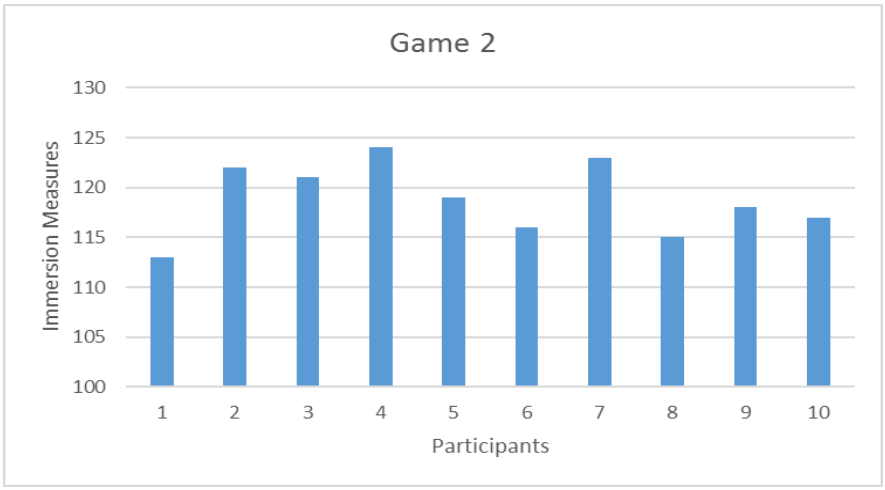

Figure 8: Immersion scores of the players with experience between 7-12 months in CoD:BO2

The figure 8 represents the immersion scores of the participants who have experience between 7-12 months in the CoD:BO2 game. The participants no. 4 and 7 showed higher immersion levels compared to other participants.

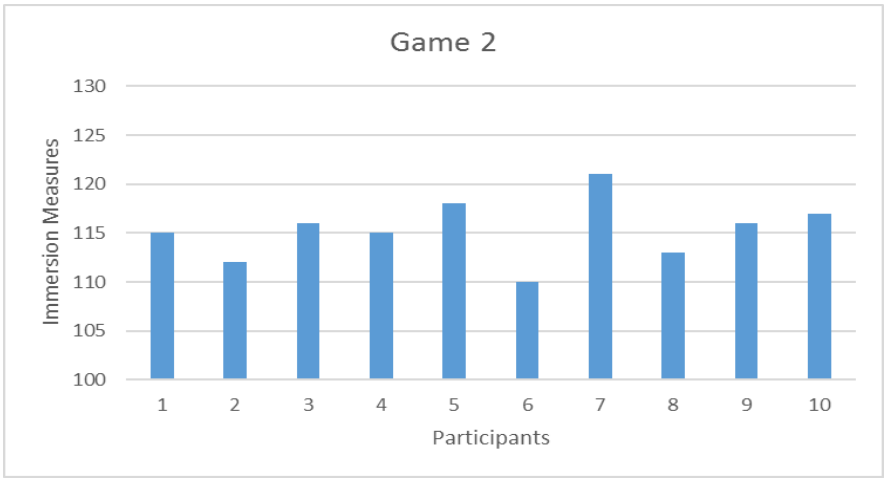

Figure 9: Immersion scores of the players with more than one year of experience in CoD:BO2

The figure 9 represents the immersion scores of the participants who have more than one year of experience in the CoD:BO2 game. The participants no. 5 and 7 showed higher immersion levels compared to other participants.

Descriptives

	Experience			Statistic	Std. Error
Immersion	Group 1	Mean		124.9000	.82260
		95% Confidence Interval for Mean	Lower Bound	123.0392	
			Upper Bound	126.7608	
		5% Trimmed Mean		125.0000	
		Median		125.0000	
		Variance		6.767	
		Std. Deviation		2.60128	
		Minimum		120.00	
		Maximum		128.00	
		Range		8.00	
		Interquartile Range		4.50	
		Skewness		-.621	.687
		Kurtosis		-.212	1.334
	Group 2	Mean		121.8000	.66332
		95% Confidence Interval for Mean	Lower Bound	120.2995	
			Upper Bound	123.3005	
		5% Trimmed Mean		121.8333	
		Median		122.0000	
		Variance		4.400	
		Std. Deviation		2.09762	
		Minimum		118.00	
		Maximum		125.00	
		Range		7.00	
		Interquartile Range		3.25	
		Skewness		-.303	.687
		Kurtosis		-.254	1.334
	Group 3	Mean		118.8000	1.15277
		95% Confidence Interval for Mean	Lower Bound	116.1922	
			Upper Bound	121.4078	
		5% Trimmed Mean		118.8333	
		Median		118.5000	
		Variance		13.289	
		Std. Deviation		3.64539	
		Minimum		113.00	
		Maximum		124.00	
		Range		11.00	
		Interquartile Range		6.50	
		Skewness		-.058	.687
		Kurtosis		-1.147	1.334

	Group 4	Mean		115.3000	.98939
		95% Confidence Interval for Mean	Lower Bound	113.0618	
			Upper Bound	117.5382	
		5% Trimmed Mean		115.2778	
		Median		115.5000	
		Variance		9.789	
		Std. Deviation		3.12872	
		Minimum		110.00	
		Maximum		121.00	
		Range		11.00	
		Interquartile Range		4.50	
		Skewness		.061	.687
		Kurtosis		.337	1.334

Table 4: Mean and Std. Deviation of the four groups of CoD:BO2 game

The table 4 consists values of mean, std. deviation, median, minimum and maximum values of all the four groups in CoD:BO2 game. Here, group 1 represents the participants with zero experience, group 2 represents the participants with 1-6 months of experience, group 3 represents the participants with 7-12 months of experience and group 4 represents the participants with more than one year of experience.

Percentiles

		Experience	Percentiles						
			5	10	25	50	75	90	95
Weighted Average(Definition 1)	Immersion	Group 1	120.0000	120.2000	122.7500	125.0000	127.2500	128.0000	.
		Group 2	118.0000	118.2000	120.0000	122.0000	123.2500	124.9000	.
		Group 3	113.0000	113.2000	115.7500	118.5000	122.2500	123.9000	.
		Group 4	110.0000	110.2000	112.7500	115.5000	117.2500	120.7000	.
Tukey's Hinges	Immersion	Group 1			123.0000	125.0000	127.0000		
		Group 2			120.0000	122.0000	123.0000		
		Group 3			116.0000	118.5000	122.0000		
		Group 4			113.0000	115.5000	117.0000		

Table 5: Percentiles of the four groups of CoD:BO2 game

The table 5 represents the percentiles of the four groups of CoD:BO2 game. Here, group 1 represents the participants with zero experience, group 2 represents the participants with 1-6 months of experience, group 3 represents the participants with 7-12 months of experience and group 4 represents the participants with more than one year of experience.

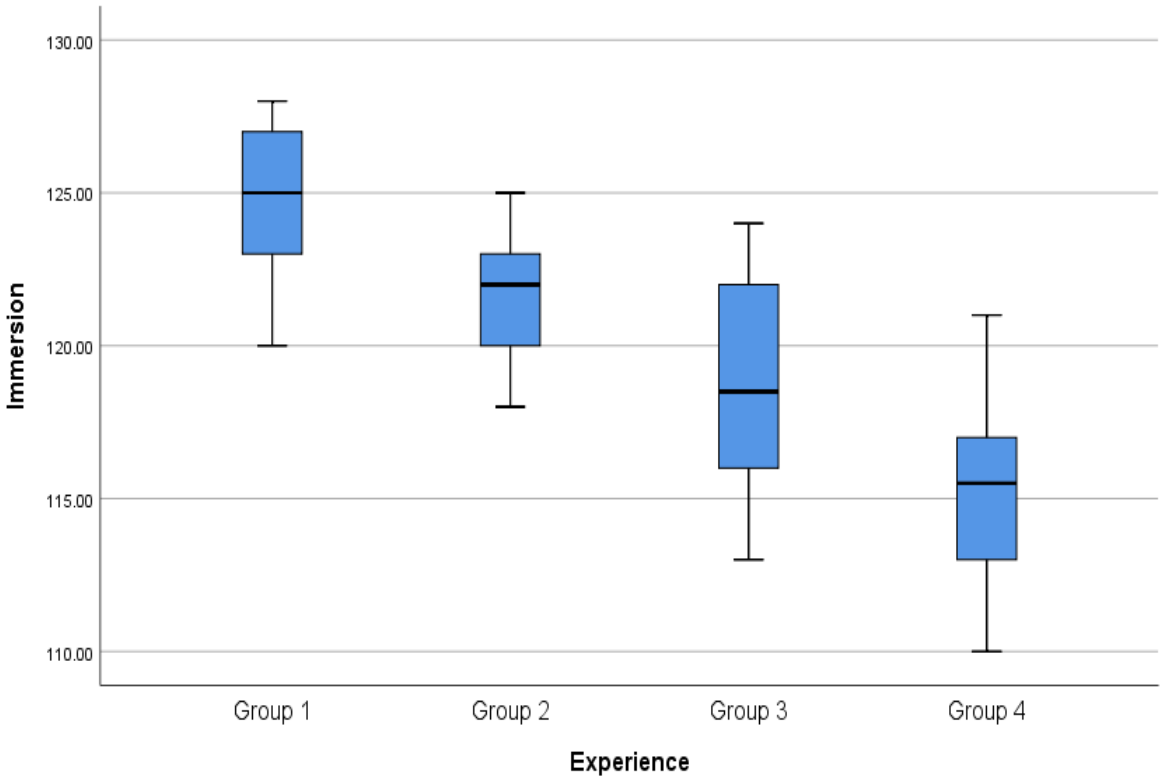

Figure 10: Boxplot representation of CoD:BO2 game

The figure 10 is the boxplot representation of CoD:BO2 game. Here, group 1 represents the participants with zero experience, group 2 represents the participants with 1-6 months of experience, group 3 represents the participants with 7-12 months of experience and group 4 represents the participants with more than one year of experience.

5 ANALYSIS AND DISCUSSION

5.1 Analysis

Analysis of the results obtained from the questionnaire is done using a statistical technique. The statistical method of analysis refers to collecting, analyzing and interpreting conclusions from the data [46].

5.1.1 Linear Regression analysis for Counter-Strike: Global Offensive

Correlations

		Immersion	Experience
Pearson Correlation	Immersion	1.000	-.761
	Experience	-.761	1.000
Sig. (1-tailed)	Immersion	.	.000
	Experience	.000	.
N	Immersion	40	40
	Experience	40	40

Table 6: Values of regression analysis for CS: GO

The Pearson's Correlation coefficient (R) provides the information about the strength and direction of the relationship between the variables. The value of R is <0. This indicates that there is inverse relationship between the variables.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.761[a]	.579	.568	2.886

a. Predictors: (Constant), Experience

b. Dependent Variable: Immersion

Table 7: Values of regression analysis for CS: GO

R^2 means square of the Pearson's Correlation coefficient. The value of $R^2 = 0.579$, this means that 58% of the variance in game immersion is due to the player's game experience.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	123.895	.650		190.623	.000	122.579	125.211
	Experience	-.389	.054	-.761	-7.228	.000	-.498	-.280

a. Dependent Variable: Immersion

Table 8: Values of regression analysis for CS: GO

The linear regression analysis was conducted with 95 percent confidence interval and the p-value is 0 for the game Counter-Strike: Global Offensive which is less than the significance value (i.e., $0 < 0.05$) which concludes to reject null hypothesis.

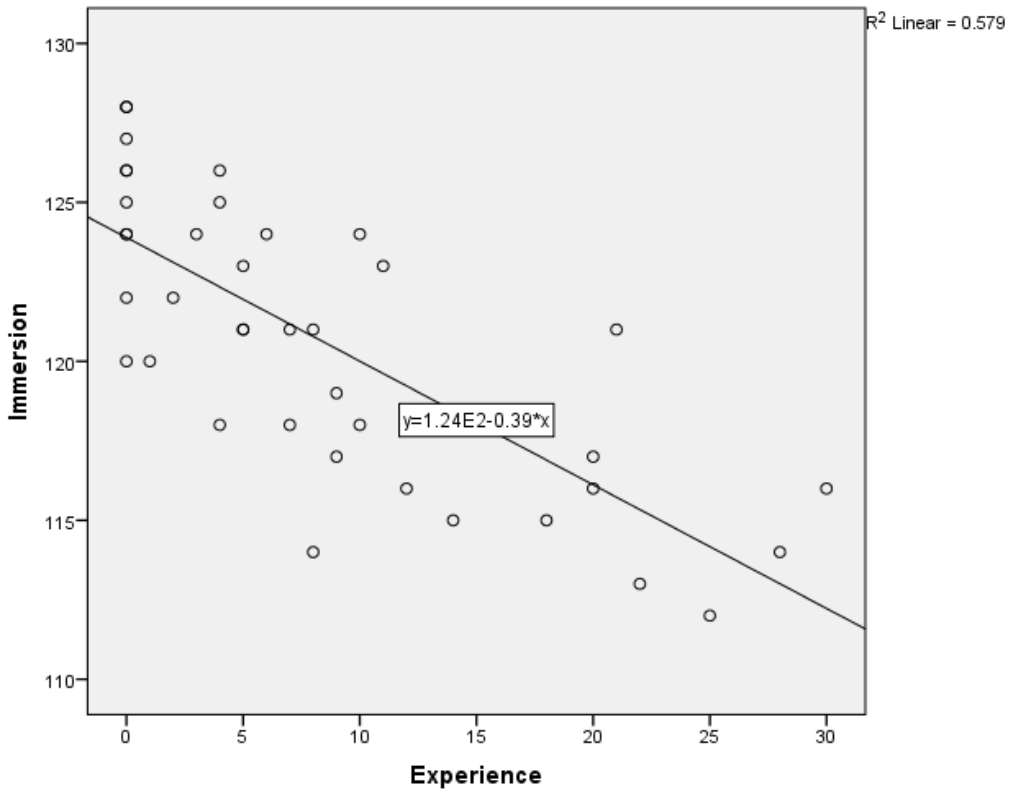

Figure 11: Linear regression for CS: GO

5.1.2 Linear Regression analysis for Call of Duty: Black Ops 2

Correlations

		Immersion	Experience
Pearson Correlation	Immersion	1.000	-.751
	Experience	-.751	1.000
Sig. (1-tailed)	Immersion	.	.000
	Experience	.000	.
N	Immersion	40	40
	Experience	40	40

Table 9: Values of regression analysis for CoD:BO2

The Pearson's Correlation coefficient (R) provides the information about the strength and direction of the relationship between the variables. The value of R is <0. This indicates that there is inverse relationship between the variables.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.751[a]	.564	.552	3.057

a. Predictors: (Constant), Experience

b. Dependent Variable: Immersion

Table 10: Values of regression analysis for CoD:BO2

R^2 means square of the Pearson's Correlation coefficient. The value of $R^2 = 0.564$, this means that 56% of the variance in game immersion is due to the player's game experience.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	123.647	.690		179.322	.000	122.251	125.043
	Experience	-.410	.059	-.751	-7.010	.000	-.529	-.292

a. Dependent Variable: Immersion

Table 11: Values of regression analysis for CoD:BO2

The linear regression analysis was conducted with 95 percent confidence interval and the p-value is 0 for the game Call of Duty: Black Ops 2 which is less than the significance value (i.e., 0 < 0.05) which concludes to reject null hypothesis.

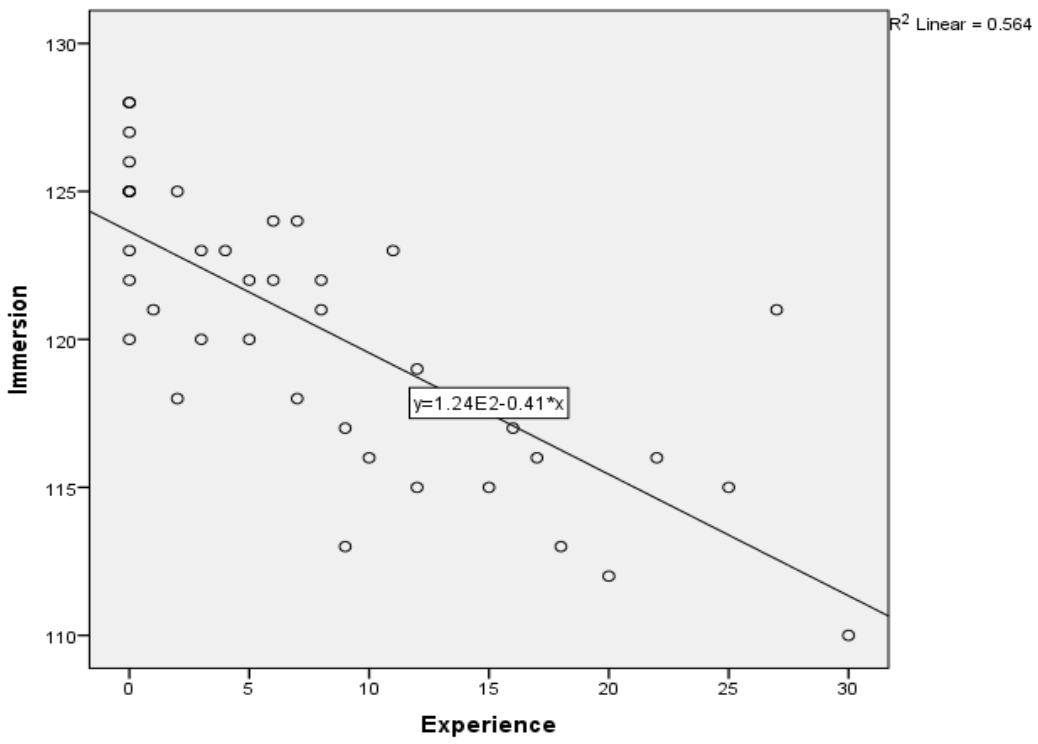

Figure 12: Linear regression for CoD:BO2

5.2 Discussions

The main aim of this research was to explore the relationship between the game immersion and the player's level of game experience. The game immersion is measured and calculated for all the players with different levels of experience in the selected games. As mentioned before the IEQ was used to measure the players' game immersion.

The players' experience in this research related to the selected game was categorized into four levels: zero experience, 1-6 months of experience, 7-12 months of experience and more than one year of experience. The immersion levels of the participants decreased in relative to the increase in the participants' level of game experience in both the games. The Correlation coefficient value R was less than zero for both the games and an inverse linear regression was observed. The R^2 value for the game CS: GO was 0.579 that means 58% of the variance in game immersion is due to the game experience and for CoD:BO2 the R^2 value was 0.564 that means 56 % of the variance in game immersion is due to the game experience. Therefore, these observations clearly represent that there is an inverse relationship between game immersion and game experience i.e., game immersion levels decrease with the increase in the game experience.

The results obtained in this research shows a considerable support for the study of C.Jennett for the findings of RWD, i.e., a game that is more appealing and interesting makes the player to get dissociated from the real world [2] and also to the study of [23] in which the author found that there is a large significant difference in the game immersion levels between experienced players and inexperienced players. The experienced players, as they had some knowledge on the game found it simple, whereas inexperienced players found it more appealing and interesting and showed in learning and playing the game [23]. In both the games the players with zero experience showed relatively high immersion levels. This means that players with zero experience find the game more appealing and interesting and also, they try to learn and interact more with the game environment.

In this research, it would have been better if statistical power analysis was used for estimating the sample size. Initially, 40 was the sample size considered for each game in the experiment. It yielded conclusive results assuring the sample size was adequate. However, statistical power analysis could have been used to know whether the taken sample size is optimal or not for the experiment.

In this study, it might have contributed to better understanding of relation between immersion and game experience, if hours played per week or months is taken into account while calculating gamer experience. For instance, some might play the game 2-3 hour per months, while others might play 10 hours every day, but all of them might have played the game for 3 months so all fall within the 2nd group as per this study.

5.3 Threats to Validity

Internal Validity:

In the context of this research internal validity threat could occur due to the questionnaire used to extract game immersion scores. The questionnaire used in this study i.e. Immersive experience questionnaire is reviewed several times and a pilot study is done to make sure the results could be possible with the questionnaire. Also, the questionnaire is based from literature where it was used by previous researchers to successfully evaluate game immersion. Respondent bias could be another internal validity threat. The questionnaire was

made to answer immediately after the game was played. This ensured that the gamer do not forget or dilute the gaming experience and provide more accurate answers.

External Validity:

The threat that could affect the applicability of this study for more wider population could be the sampling strategy used in this study. Convenience sampling is used to select the subjects(gamers) for this study. With this approach, it poses a major threat with generalization of obtained results. To counter and mitigate this threat, the sample is chosen with as much varying attributes as possible to cover wider population. For example, the gamers were randomly chosen for attributes like gender, games played and their gaming experience. This approach ensured that the sample represented the population.

6 CONCLUSION AND FUTURE WORK

6.1 Conclusion

From this research, it can be concluded that there is an inverse relationship between game immersion and game experience i.e., the game immersion levels decrease with the increase in the game experience. From this it can be concluded that the player's ability and interest to learn and play new games makes the player to get more immersed into the game.

6.2 Answering of Research Questions

RQ1: How can game immersion be measured subjectively?
Answer: From the literature review conducted, the different methods to measure immersion were explored. The methods include subjective methods and objective methods. Objective methods include measuring of eye movements using eye tracker and subjective methods include questionnaires. For this research, subjective method was considered to measure game immersion and the questionnaire used was IEQ.

RQ2: What is the relation between the experience of gamers and their level of game immersion?
Answer: User studies were performed in the form an experiment. Two games were chosen for this experiment and the players were categorized into four levels of experience. After players played the game they were asked to answer the IEQ questionnaire. The results obtained from the questionnaire were then calculated and analyzed using regression analysis. From the regression analysis, it was observed that there is an inverse relationship between the game immersion and game experience i.e., the game immersion levels decreased with the increase in the level of game experience.

6.3 Future Work

Further in the future it would interesting to explore the relation between the players' game immersion and players' level of game experience objectively by using eye tracking devices or by using galvanic measurements. It would also be interesting to see how game immersion relates to overall game satisfaction.

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APPENDIX

Questionnaire

Please rate how far will you agree with the statements below.
1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree;

1. To what extent did the game hold your attention?
   strongly disagree 1 2 3 4 5 strongly agree

2. To what extent did you feel you were focused on the game?
   strongly disagree 1 2 3 4 5 strongly agree

3. How much effort did you put into playing the game?
   strongly disagree 1 2 3 4 5 strongly agree

4. Did you feel that you were trying you best?
   strongly disagree 1 2 3 4 5 strongly agree

5. To what extent did you lose track of time?
   strongly disagree 1 2 3 4 5 strongly agree

6. To what extent did you feel consciously aware of being in the real world whilst playing?
   strongly disagree 1 2 3 4 5 strongly agree

7. To what extent did you forget about your everyday concerns?
   strongly disagree 1 2 3 4 5 strongly agree

8. To what extent were you aware of yourself in your surroundings?
   strongly disagree 1 2 3 4 5 strongly agree

9. To what extent did you notice events taking place around you?
   strongly disagree 1 2 3 4 5 strongly agree

10. Did you feel the urge at any point to stop playing and see what was happening around you?
    strongly disagree 1 2 3 4 5 strongly agree

11. To what extent did you feel that you were interacting with the game environment?
    strongly disagree 1 2 3 4 5 strongly agree

12. To what extent did you feel as though you were separated from your real-world environment?
    strongly disagree 1 2 3 4 5 strongly agree

13. To what extent did you feel that the game was something you were experiencing, rather than something you were just doing?
    strongly disagree 1 2 3 4 5 strongly agree

14. To what extent was your sense of being in the game environment stronger than your sense of being in the real world?
    strongly disagree 1 2 3 4 5 strongly agree

15. At any point did you find yourself become so involved that you were unaware you were even using controls?
    strongly disagree 1 2 3 4 5 strongly agree

16. To what extent did you feel as though you were moving through the game according to your own will?
    strongly disagree 1 2 3 4 5 strongly agree

17. To what extent did you find the game challenging?
    strongly disagree 1 2 3 4 5 strongly agree

18. Were there any times during the game in which you just wanted to give up?
    strongly disagree 1 2 3 4 5 strongly agree

19. To what extent did you feel motivated while playing?
    strongly disagree 1 2 3 4 5 strongly agree

20. To what extent did you find the game easy?
    strongly disagree 1 2 3 4 5 strongly agree

21. To what extent did you feel like you were making progress towards the end of the game?
    strongly disagree 1 2 3 4 5 strongly agree

22. How well do you think you performed in the game?
    strongly disagree 1 2 3 4 5 strongly agree

23. To what extent did you feel emotionally attached to the game?
    strongly disagree 1 2 3 4 5 strongly agree

24. To what extent were you interested in seeing how the game's events would progress?
    strongly disagree 1 2 3 4 5 strongly agree

25. How much did you want to "win" the game?
    strongly disagree 1 2 3 4 5 strongly agree

26. Were you in suspense about whether or not you would win or lose the game?
    strongly disagree 1 2 3 4 5 strongly agree

27. At any point did you find yourself become so involved that you wanted to speak to the game directly?
    strongly disagree 1 2 3 4 5 strongly agree

28. To what extent did you enjoy the graphics and the imagery?
    strongly disagree 1 2 3 4 5 strongly agree

29. How much would you say you enjoyed playing the game?
    strongly disagree 1 2 3 4 5 strongly agree

30. When interrupted, were you disappointed that the game was over?
    strongly disagree 1 2 3 4 5 strongly agree

31. Would you like to play the game again?
    strongly disagree 1 2 3 4 5 strongly agree