The Influence of Situational Factors and Gamification on Intrinsic Motivation and Learning

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Abstract. Immersive virtual reality (iVR) is becoming increasingly popular for learning. But how such learning applications are designed is crucial and determines their success. Designing suitable feedback mechanisms in a learning environment manifests through gamification elements. Nevertheless, previous research has shown that the effect of gamification is ambiguous and depends on several aspects. The setting in which the gamification is used can affect the learner's perception of the feedback and, in turn, their motivation. Since learning systems are usually aimed at increasing the user's learning performance but also their inherent enjoyment of learning, investigating effects on the user's intrinsic motivation is essential. This study proposes a research model, and an experimental approach is outlined in order to examine how situational factors influence the effect of gamification on intrinsic motivation and learning performance in iVR learning environments.

Keywords: Learning, Immersive Virtual Reality, Intrinsic Motivation, Gamification, Situational Factors.

1 Introduction

Virtual Reality applications are becoming increasingly popular since the rise of Oculus Rift (Development Kit 2) in 2016. Especially, immersive Virtual Reality (iVR), realized by presenting a virtual environment through a head-mounted display (HMD) which encloses the user into the virtual world and lets the them interact within it by using hand-held controller, is used in different domains and fields. One area of application for iVR is learning [1]. Due to the nature of this technology, different contexts and scenarios can be displayed allowing the user to be completely involved and immersed into the given setting and task within it. Such applications are already deployed at schools and universities as well as in healthcare and process learning [2]. Not only does immersion and interactivity allow for engagement and fun [3], it also furthers concentration by eliminating external distractions [4]. Such deep involvement with the task presented in the virtual environment shows a positive influence on learning and performance [5].

Another important aspect of learning, especially in iVR, is feedback. Evaluating the user's actions and showing them if and what was performed correctly or could be

14th International Conference on Wirtschaftsinformatik,
February 24-27, 2019, Siegen, Germany

improved is a key aspect of improving their learning performance and avoiding the habituation of erroneous behavior. A popular approach for realizing such technological feedback within such systems is gamification [6]. Gamification can be found in different settings. By applying game elements to work- or learning-related contexts and tasks it provides feedback in a game-like fashion. It is designed to motivate users by awarding them points, badges and level-ups, etc. for desired, correct behavior within the given context or for the specific task.

The aim of such feedback and reward systems is to achieve the fulfillment of the need for competence. This, in turn, is aimed to increase the intrinsic motivation of the users such that they perform the activity for its own sake [7]. This way, the enjoyment and performance of the user is increased inherently through the performance of the task instead of externally motivated by the expectation of rewards [7]. But how gamification is influencing the user's motivation and performance has rarely been empirically investigated [6]. Whether the intended growth in intrinsic motivation actually takes place by introducing gamification to learning tasks and scenarios is not yet clear [6].

While feedback systems and rewards, as they are used in gamified applications, are usually considered to be extrinsic motivators, it is important that these do not reduce but rather even heighten the intrinsic motivation of users - not only because long-term performance and engagement are dependent on intrinsic motivation but also the user's satisfaction and their overall well-being [8]. Hence, it is essential to investigate how gamification can be utilized such that it does not stifle but foster intrinsic motivation and with that the long-term performance, satisfaction and well-being of the user.

This question is difficult to answer as the effect of gamification varies depending on the context it is used in, how it is designed and realized and what situation it is used in. Mekler et al. demonstrate how situational factors have an impact on the performance of users as well as on their intrinsic motivation [9]: If the feedback in the gamified application is understood and perceived by the user as neutral and merely informational, it positively impacts the user's intrinsic motivation. However, if through the situational factors the feedback is perceived as controlling, it has a negative influence on the user's intrinsic motivation. As a consequence, this shows the importance of not only the feedback itself but also points to the significance of its perception by the user. Investigating how the effect of gamification, especially within an iVR setting, is influenced by situational factors promises to deliver clues as to how the intrinsic motivation of a user as well as their learning performance is affected and how these aspects need to be integrated into an iVR learning setup and application. Therefore, this work-in-progress paper proposes an experimental setup with which the following research question can be addressed:

RQ: How do situational factors influence the effect of gamification on intrinsic motivation and with that learning performance in an iVR learning environment?

To answer this research question, the paper is structured as follows. In Section 2 the research background on iVR, gamification and intrinsic motivation is presented. The hypothesis development and the research model are outlined in section 3, followed by the description of the research method and intended data analysis in section 4. Lastly, in section 5 an initial discussion and an outlook is presented.

2 Background and Literature Research

2.1 Immersive Virtual Reality

Immersive Virtual Reality (iVR) is achieved by using complex interfaces and hardware, such as head-mounted displays (HMD), which allows the user to be completely shut off from their surrounding and exclusively perceive the virtual environment. By using controllers or through hand-gestures the user is able to interact with the virtual world and the objects within it. This kind of immersion can lead to the feeling of (tele)presence in the virtual environment and a sense of actually being in this virtual world [10, 11]. This immersion and sense of presence increases engagement with the virtual environment and in turn with the task within it [5]. Besides this, iVR offers several advantages. Due to that, it is used as the environment of choice for many learning applications. For instance, because of the provided interactivity iVR environments are used as medical training tools for medical students [12]. Another example of such applications are games helping students in certain areas of math like, for example, geometry [13]. The main reasons why iVR is utilized in such cases is that it allows to visualize and display complex and abstract information and explanations in a more tangible and interactive way. Enabling this type of interactivity and good visualization positively influences learning outcomes [5] which is why iVR is a popular tool for realizing learning application and serious games.

2.2 Intrinsic Motivation

Intrinsic Motivation is defined as the drive to do a certain activity for its own sake rather than because of any expected consequences or rewards which follow it [14]. As opposed to extrinsically motivated activity, which is elicited by anticipated external rewards and, therefore, dependent on external factors, intrinsically motivated behavior driven by the inherent joy of the activity. In order to reach and foster this intrinsic type of motivation, it is important to fulfill certain needs. According to the Self-Determination Theory by Ryan and Deci [8], increased intrinsic motivation, and with that, well-being can be achieved by meeting the psychological needs of competence, social relatedness and autonomy. This means that by creating and enabling (social) structures and situations which allow the fulfillment of these needs or at least a part of them, the development of self-motivation and overall healthy mental development and state can be supported [8].

In order to foster intrinsic motivation towards learning, it is important to take these psychological needs into account. Since a crucial part of learning is based on receiving feedback [15], the way in which this feedback is presented can influence the satisfaction and fulfillment of these needs. It is important that external feedback does not diminish but rather support intrinsic motivation. To be able to provide feedback in a helpful fashion such that it can promote feelings of competence and/or autonomy could positively affect the overall motivation to learn. As a consequence, integrating this insight and designing learning applications and feedback mechanisms with this type of need satisfaction in mind can be beneficial.

2.3 Gamification and Situational Factors

Gamification can be understood as the application of game elements to non-game contexts [16]. Which elements are utilized can vary: for example, it is possible to include ranks, badges, levels, etc. [16]. Hamari et al. [3] demonstrated, through their meta-analysis of 24 gamification studies, that such game elements have a positive effect on users. Two effects which were found across all studies are fun and engagement. This is supported by the results from Buckley et al. [17], who also found that gamification positively affects users. However, the impact of each element depends on the context in which it is used as well as how it is implemented [3, 18]. An important game element which is frequently used in gamified applications and which is also highly context-sensitive is feedback [16]. Feedback can be realized and displayed to the user in several forms with the most common and basic type being points [19]. They are the basic building block on which other elements such as level-ups and badges, for instance, are based on. Points are the simplest form of reward and feedback for certain actions within a game or task [6, 20, 21].

How the user perceives this feedback is crucial. If it is understood as purely informational it can support the fulfillment of the psychological needs mentioned above. But if the user experiences it as controlling, it can stifle intrinsic motivation and only be extrinsically motivating [8]. Therefore, if the points and the setting and context in which they are presented to the user are informational, this can lead to an increase in their perceived competence [19, 21]. However, if the situational factors are such that the feedback from the points is considered controlling, they could increase a feeling of pressure and therefore diminish intrinsic motivation.

Mekler et al. [6] showed that the game element of points can not only provide feedback to the user but can increase their intrinsic motivation in an image annotation task. For this, they let the user name and tag images on a computer and provided points for quantity and quality of their tags. Their findings show an increase of intrinsic motivation in subjects who received feedback in the form of points for their actions as opposed to the control group who did not receive any feedback in form of points. However, there are also findings, for instance by Mekler et al. [18] and Sailer et al. [21], which demonstrate that the gamification elements, as points, are not necessarily effective in increasing intrinsic motivation per se.

3 Research Model and Hypothesis Development

In this section the research model is proposed, and the hypotheses will be derived (Figure 1). While previous research does not conclusively show that higher intrinsic motivation leads to increased learning, there are clear tendencies in this direction. Intrinsically motivated subjects often demonstrate at least equal or better learning performances to their extrinsically motivated counterparts. Several studies showed the positive influence of higher intrinsic motivation on learning [22], goal achievement [23] and persistence in education, i.e. lower drop-out rate in education [24]. This points to a positive influence of intrinsic motivation on, especially long-term, learning. Based on this, users of a learning system who exhibit increased intrinsic motivation should be

able to show higher learning performance than those who are less intrinsically motivated. This leads to the first hypothesis:

H1: Intrinsic motivation positively influences the learning.

Furthermore, studies like Hamari et al. [3], have clearly demonstrated that the effect of gamification is positive on engagement, fun, and partly on learning outcome [5] and intrinsic motivation [6]. Since the user has to be attentive and is engaged as if they play a game, such positive effects can occur. However, since such results are not conclusive, this needs to be further investigated. In addition, to the best of our knowledge, none of the previously conducted studies on gamification and situational factors are set within and focused on an iVR technologies. Using gamification elements to provide neutral feedback and increase the feeling of competence can lead to fostering intrinsic motivation. Since points are the most basic game element on which previous research builds upon ([19], [21]) it is picked as the element of choice in this study. By combining these aspects, the second hypothesis is:

H2: Providing feedback in an iVR learning environment in form of points, as a gamification element, positively influences intrinsic motivation.

However, the effectiveness of such gamification elements dependent on which game element is used specifically, how it is integrated, and in which context it is embedded in [3, 18, 21]. Therefore, it is important to account for situational factors which could influence the perception and with that the effect of the feedback. Examining situational settings is, therefore, crucial as well. By creating situational settings which can either be considered controlling or informational and neutral allows for an investigation into these situational factors and their impact on the user's intrinsic motivation [8]. Hence, if users perceive the gamification feedback as informational and neutral, they will be more intrinsically motivated than in a controlling setting since no external pressure will affect their performance. This leads to the third hypothesis:

H3a: Adjusting situational factors such that the gamification element is perceived as informational rather than controlling will positively influence intrinsic motivation.

But even if the gamification element and, therefore, a learning or performance feedback is omitted, previous research shows that situational factors still are of important. Situational factors, for example, as the allocation of authority and power, can influence intrinsic interest [25]. In addition, a setting strongly emphasizing the importance of good performance tends to induce pressure and is found to be negatively correlated with intrinsic interest [26]. In contrast, a neutral setting which is focused on learning instead of performance is less pressure-inducing and positively correlated with intrinsic interest [26]. This means, adjusting the situational factors such that they are neutral should lead to higher intrinsic motivation compared to a controlling setting. Therefore, the last hypothesis follows:

H3b: Adjusting situational factors such that they create an informational and neutral setting positively influences intrinsic motivation as opposed to a controlling setting.

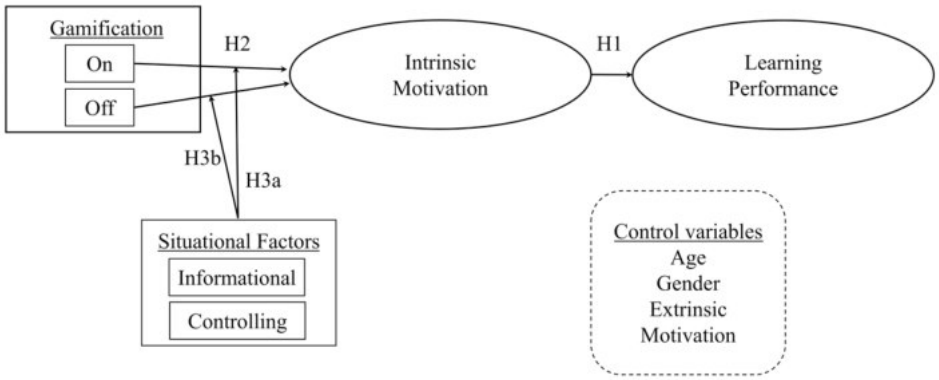

Figure 1. Research Model

4 Method

4.1 Design and Participants

In order to investigate the research question at hand, a randomized 2 (gamification: on vs. off) x 2 (situational factors: informational/neutral vs. controlling) between-subject experimental set up will be used. The experiment will take place in a laboratory in which the participants will be set in a virtual environment, implemented in Unreal Engine 4. For this, an HTC Vive VR-HMD and its controllers will be used. This allows full visual immersion into the virtual environment and interactivity by moving around and move virtual objects. The aim is to recruit 120 participants, with 30 participants per group, with most of them being university students who will receive monetary compensation for their participation in the experiment.

4.2 Learning Task

The learning task used in the experiment is set in a virtual post office. The task is based on the processes in real post offices. This post office is set up in the following way. The participants will stand in front of a desk behind a counter. The customers enter and interact with them straight ahead from this standpoint. In front of them, on the desk, are a scale which allows them to weigh an item and simultaneously show them its measurements like height and length. In addition to that, the stamps and tags for special orders and requests are on the desk. To their left, on the wall, is the price list as well as specific boxes for certain sizes of items. The participants are required to take the role

of a post worker interacting with a virtual customer. The customer gives the participant a postcard, letter or package to mail. Which item is brought in by the customer is randomized such that the process varies in each trail. The participant's task is then to execute all necessary steps in order to successfully set up the shipment of the customer's item. That way, the participant is supposed to learn the execution of the customer interaction and shipping process. The steps taught in the experiment at hand will be described in the following:

1. Receive customer item and listen/read their instructions (for example, how should the letter be mailed)
2. If special order: add tag
3. Weigh and measure the customer's item
4. Look up the price of such an item on a price list
5. Bill the customer accordingly by typing in the right price into a number pad
6. Attach stamp to the item
7. Sort the item according to its size and weight into the right shipment box

Occasionally, a customer will have a special order or requirement which adds an extra step (see step 2). At this point, they have to an attach a tag that indicates that this is, for example, express shipment.

The system is designed in a way such that it does not allow for the participant to make a mistake and finish the process regardless of that. Instead, the participant cannot continue with the next steps until the mistake it corrected, and the steps can be followed in the right order again.

4.3 Procedure

The experiment takes place in a virtual reality laboratory and participants are tested individually. Firstly, the participants receive a short introduction by the experimenter regarding the consent form and the general set up of the experiment. If participant decide to take part, they receive oral as well as written instructions by the experimenter regarding the task. After the task is clear and the participant knows what to do, the experimenter explains how the VR Headset and its controllers work and how participants can navigate and interact in the virtual world.

Given that the participant is in the group in which the gamification is tested, they will see a board in the virtual post office on the upper right corner of the virtual desk they are working on. On this board their current point score will be displayed. If the participant is in the non-gamification group of subjects, the board will not be shown. Instead of serving as extrinsic motivators, these points are aimed to increase the subject's perceived competence and in turn intrinsically motivate them.

Depending on which condition the participant is in, they either receive task instructions which are phrased in an informational and neutral or in a controlling way. The instructions are based on the ones used in an experiment by Shalley and Smith [27]. The phrasing is specifically adjusted in each condition with either neutral or pressure-

inducing and autonomy-depriving words [28]. In the controlling condition, the participants are also told by the experimenter that they are an important part of the study, that they will be observed for the purpose of evaluating their performance during the task and that the time they take to finish the task will be measured as well. They are explicitly told to make no mistakes while working through the task as fast as they can. By introducing these instructions, we assume that the feeling of pressure will be increased in those subjects. The participants in the other group with neutral instructions are just told that they are a part of the study, that they should just simply try to do their best but that they are in no hurry and if something goes wrong it is not a problem. They also get told that the experimenter will be watching what they are doing, however, they are assured that this is just for their safety so that the experimenter can make sure that they do not bump into objects.

After an initial training period to get used to the environment and to the setting and interactions, the participants are required to start the task and their time and number of errors will be taken by the experimenter. After ten trails are completed, they can stop. Lastly, they get asked to complete a questionnaire for which they have to indicate their degree of agreement with certain statements. These statements are the items which are aimed at measuring the participants level of intrinsic motivation and perceived pressure. The measures are explained in more detail in the section below and the items used in the questionnaire can be found in Table 1 in the Appendix.

4.4 Measures

Learning Performance: To measure the learning outcome or the performance we use the point system in the virtual environment as well as an error count through observations by the experimenter. The system rewards points such that it counts three points for a process completed without mistakes, two points for a process in which one error was committed and one point for every other completed process. In addition, the experimenter will count the number of mistakes by observing the actions in the virtual environment.

Intrinsic Motivation: To measure intrinsic motivation we use the Intrinsic Motivation Inventory (IMI) [29]. Some items are adapted such that they fit this specific experiment (Appendix, Table 1).

Pressure: To measure pressure, the construct of "Pressure" within the Intrinsic Motivation Inventory was used. The items within this construct are also adapted to fit this specific experiment (Appendix, Table 1).

Perceived Learning: To measure the perceived learning of the participants, items by Goel et al. [30] were adjusted (Appendix, Table 1).

Learning Satisfaction: To measure the learning satisfaction of the participants, items by Goel et al. [30] were adjusted (Appendix, Table 1).

Manipulation Checks: Three manipulation checks are introduced. Since the display of the gamification element is manipulated in this experiment, the points are either shown or not presented to the participant. Due to this, the participants are asked whether they could collect and accumulate points from the system for their actions. Additionally, by using adjusted items by Suh et al. [31] it is checked whether the

collection of points yielded any motivational incentive for the participants. Lastly, the situational factors are adjusted such that they are either controlling or neutral. Therefore, participants are asked whether the instructions were perceived as either pressure-inducing or neutral. The manipulation checks can be found in Table 1.

4.5 Data Analysis

In order to test the hypotheses and answer the research question different statistical methods will be utilized. For instance, a multiple regression analysis and ANCOVA to check manipulations and whether the participants in each condition (non-/gamification and neutral/controlling situational factors) performed differently and exhibited (significant) distinctions in their level of intrinsic motivation.

5 Discussion

This study is aimed at investigating the influence of situational factors on gamification in an iVR learning environment and their impact on intrinsic motivation and learning outcome. This work will contribute to the body of empirical research revolving around the subjects learning in iVR (for example, [1]), intrinsic motivation (for instance, [6], [8] and [9]), and the influence of situational factors (for example [26]). In addition to that, it will inform and provide insights for practitioners and designers of learning system as well as their users. Arranging and adjusting situational factors could help to motivate the learners and improve their performance. Therefore, questions of how to deploy, use, and get the most out of such systems needs to be answered, whereby the study at hand will contribute by its findings. In order to proceed, the next step is participant recruitment and conducting the experiment.

As every study, this research has certain limitations. Although gamification elements might affect the intrinsic motivation of a person, there might be further design-related and non-design aspect that affect the individuals' motivation. Hence, future research should extend this perspective by including other factors as well. For instance, future research might investigate alternative gamification elements (e.g., batches, leaderboard, etc.) as a promising aspect to influence learning performance and variation in motivation in more detail. Finally, since an experimental approach is proposed here, external validity might be an issue which could be considered in further studies.

6 Acknowledgements

This article was supported by project ELISE and by a grant provided by the German Federal Ministry of Education and Research (BMBF) (No. 16SV7512).

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Appendix

Table 1. Constructs and Examples of Items for Experiment.
For all items, participants have to indicate to which degree they agree with the given statement on a scale from 1 (not agree at all) to 7 (completely agree).

Construct		**Items - Examples**
Intrinsic Motivation Inventory (IMI) [29]	Enjoyment/Interest	I thought the task was quite enjoyable. I would describe the task as very interesting.
	Perceived Competence	I am satisfied with my performance at this task. I think I am pretty good at the task.
	Perceived Choice	I believe I had some choice about doing the task. I did the task because I wanted to.
	Effort/Importance	I put a lot of effort into doing the task. It was important to me to do well at this task.
	Pressure/Tension	I felt very tense while doing this task. I felt pressured while doing the task.
Perceived Learning [30]		Doing the task increased my knowledge about the process.
Learning Satisfaction [30]		I am satisfied with the way I learned about the process.
Awareness of Point System (MC) [self-developed]		The system offers me the possibility to accumulate points I have gained.
Points and Motivation (Manipulation Check) [self-developed]		The system motivated me by offering the possibility to obtain more points if I try hard.
Situational Factors (Manipulation Check) [self-developed]		I felt pressured by how I was instructed to do the task.