Voluntary Play in Serious Games

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Abstract. Voluntariness is an important feature of games. Serious game designers intend to generate engaging gameplay, which implies that voluntary play should be equally important for serious games as for entertainment games. This paper describes the outcome of a study on the impact of voluntariness on learning in a serious game. The results of 19 participants, randomly assigned to voluntary and mandatory gameplay, are analyzed to identify possible differences. The findings of this study suggest that, contrary to the opinion of many game designers, being required to play a serious game does not necessarily take the fun out of the game.

Keywords: serious games · effectiveness · learning effect · freedom of choice

1. Introduction

Serious games are "games that do not have entertainment, enjoyment or fun as their primary purpose" [1]. Over the last two decades they have become a substantial research topic in the educational field [2]. Especially the effectiveness of serious games has been much researched. These studies mainly focused on comparing the effects of serious gaming to those of traditional learning methods [3]. However, traditional learning methods are usually mandatory in nature, whereas serious gaming may have a more voluntary character offering a student freedom of choice. Psychological studies have revealed positive effects of freedom of choice on motivation and participation [4,5], making it plausible that it will also have a positive impact on the learning effect. Yet, to the best of our knowledge, no studies have taken into account the possible impact of freedom of choice within serious gaming (i.e., voluntary versus mandatory gameplay) on the effectiveness of the games.

The purpose of this study is to determine whether, and to what extent, gameplay (duration and score) and learning effect (test scores) of a serious game are affected by students' freedom of choice to play this game or to use alternative (text based) learning materials instead.

2. Background of the Study

Games have been used in training for centuries [6]. Although the term 'serious game' had been used in different contexts before [7], Abt [8] introduced the term in relation to instruction. In his view, the instructional aspect did not have to be incorporated into the game itself, but could also be part of the context. In 2002 the term was focused toward digital games [9]. Nowadays, serious games are defined as (digital) games with a main purpose other than entertainment, enjoyment or fun [1]. When the main purpose is educational, serious games are also known as instructional games or game based learning.

At the basis of the definition of serious games lies the definition of games in general. Salen and Zimmerman [10] define games as "systems in which players engage in an artificial conflict, defined by rules that result in a quantifiable outcome", and McGonigal [11] defines them as "activities with a goal, rules, a feedback system, and voluntary participation". Other scholars on game and play also include "voluntary" or "free" in their definitions of games [1], [12,13,14]. While there is not a particular definition of games that is universally accepted, game designers have reached considerable consensus about the main principles of games, although a game does not necessarily need to satisfy all principles. Games often have rules, goals, a storyline, and outcomes; they offer interaction, feedback, and competition. Furthermore, and critically important: they are played voluntarily and they are fun, or as they can be frustrating at times – at least they are 'immersive' or 'engaging'. A game should deeply absorb the player.

Most definitions of serious games originate directly from game definitions. Especially on account of the fun characteristic of games the term "serious games" appears to be an oxymoron. If games are fun by definition, they cannot be serious at the same time [16]. Also, games are non-productive and separate from the real world [12], whereas serious games have specific learning objectives related to life or work skills [14]. Callois [13] has even stated that it ceases to be play when this play of a game is forced. Thus, games should be played voluntarily. Yet serious games are meant to be instructional and instruction is typically non-voluntary [14]. This paradox may have an impact on player attitude and as such on the learning effect of the serious game. Players may have a more positive attitude when they are allowed the freedom to choose to play a serious game. In contrast, Huizinga [12] also stated that play is a serious activity, and that fun and serious do not necessarily exclude one another.

Offering learners a choice in their assignments empowers them to take control, which provides them ownership of the learning process and motivates them to be engaged. This increases interest and, with that, it increases time spent on the chosen assignment [17]. The freedom to choose what, when, and how to contribute in the learning process can motivate learners to actively participate and accomplish more. These factors have also been identified as having a positive impact on the effectiveness of serious games.

In a study of forced play, Heeter et al. [4] found that non-players are likely to be at a disadvantage in serious gaming, as obtaining the intended effect of a serious game depends on how well the game is played. The negative affect that non-gamers experience in a game are expected to interfere with learning or with the cognitive benefits. Their study also showed that resistant players have less attention for the

game they have to play and that they experience less positive and more negative feelings about that game. They would not play the game if they did not have to. Heeter et al. concluded that serious games are least effective for players who dislike a game and most effective for those who like it.

Closely related to freedom of choice is the topic of consent. Mollick and Rothbard [5] examined the role of consent as a psychological response to "mandatory fun" in gamification in the work environment. They found that games which employees consented to significantly increased their positive affect, while resistance resulted in a decrease in positive affect and a marginal decrease in performance. They also identified two sources of consent. Employees who play games outside of work were more likely to consent to them in other settings, and individuals who were allowed to choose which game to play showed higher levels of consent and perceived control. The latter may coincide with the freedom to choose to play a serious game or not, leading us to expect that playing a serious game voluntarily will increase positive affect and possibly performance.

Based on the motivating aspect of choice and the original definition of games we expect that voluntariness or freedom of choice will have a positive impact on the learning effect of serious games.

3. Experiment

The purpose of our experiment is to determine whether using the game voluntarily as a learning tool will result in improved player performance as opposed to mandatory gameplay. The experiment consists of a short training and a test of knowledge and application questions. The independent variables in this research are each participant's gender, age, and interest in gaming. The dependent variables are game score, test score, and time spent playing the game. In this section the recruitment of participants and the experimental design will be discussed, followed by our procedure and the materials.

3.1. Participants and Design

Participants have been recruited through various social media and by personal invitation. Only persons over the age of 18 were selected to participate. They were asked to give their informed consent before being registered. As an incentive participants were offered a chance to win a € 100 gift certificate. Chances of winning are related to completing all stages of the experiment, not to personal results.

A total of 62 persons (37 male and 25 female; mean age 43 years, ranging from 19 to 75) registered for the experiment and completed an online survey with demographic information and levels of motivation and prior knowledge. They were randomly assigned to one of two groups, resulting in a voluntary gameplay group of 29 participants and a mandatory gameplay group of 35 participants. The participants will be referred to as 'voluntary players' and 'mandatory players' respectively. In the experiment voluntary players will be free to decide if and how long they want to play the game, while mandatory players will be required to play the game for at least ten

minutes. Twenty participants completed the training and its test. There were 9 completes from mandatory players and 11 from voluntary players. One complete in the voluntary group was disqualified, because the participant indicated to accidentally have finished the test without playing the game. The experiment was completed in a valid way by 10 men and 9 women with a mean age of 39 (SD = 15). The groups did not differ significantly in terms of age, gender and interest in gaming.

The participants' prior knowledge on aviation and meteorology, as reported on the online survey with a possible score of ten, had a mean score of 4.16 (SD = 2.39) and did not differ significantly between test groups. However, mandatory players were more motivated to participate in the experiment than voluntary players (One-way ANOVA: $F(1,17) = 9.28$, $p < .05$).
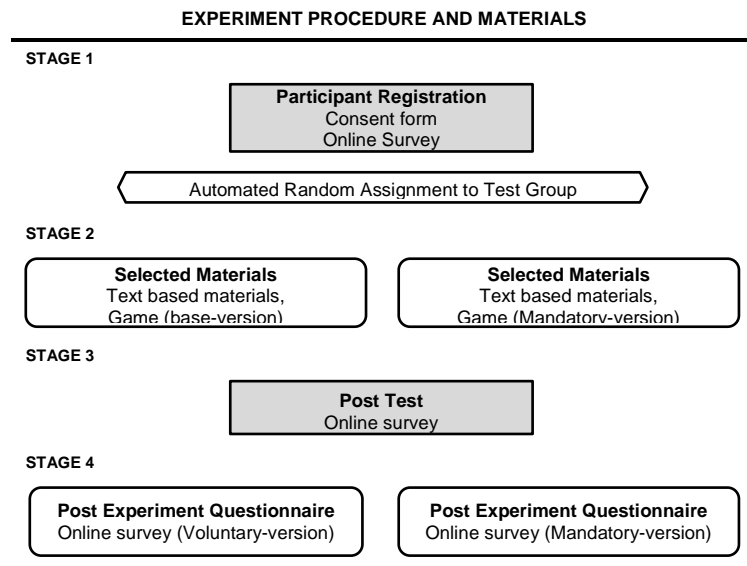
EXPERIMENT PROCEDURE AND MATERIALS

STAGE 1

> **Participant Registration**
> Consent form
> Online Survey

> Automated Random Assignment to Test Group

STAGE 2

> **Selected Materials**
> Text based materials,
> Game (base-version)

> **Selected Materials**
> Text based materials,
> Game (Mandatory-version)

STAGE 3

> **Post Test**
> Online survey

STAGE 4

> **Post Experiment Questionnaire**
> Online survey (Voluntary-version)

> **Post Experiment Questionnaire**
> Online survey (Mandatory-version)

Fig. 1. Schematic Representation of the Procedure Stages and Corresponding Materials

3.2. Procedure and Materials

The experiment consisted of four stages, shown in Fig. 1. All materials were available online. Participants could complete all stages online at their own computer and at their own convenience. Registration took place by the participant providing an e-mail address and indicating their valid age and informed consent with a check mark. At the time of registration each participant was randomly assigned to a treatment group and gained access to a webpage with the experiment instructions and materials. After registration each participant provided demographic information, information concerning prior knowledge of aviation and meteorology, and their personal motivation for participating in the experiment in an online questionnaire.

The participants were then asked to study the text based materials and play the game. Voluntary players were free to decide if and how long they played, while

mandatory players were told to spend a minimum of ten minutes playing. The text based instruction consisted of 13 webpages, offering information about cloud classification, characteristics of different cloud types, possible hazards, and the impact of clouds on aviation. It showed drawings and photographs of different types of clouds. Both test groups had unlimited access to the same set of text based materials.

The CloudAtlas Game. The game is identical for both test groups, but for the mandatory players the webpage enforced a ten minute minimum of active gameplay before allowing the player to take the test. The game is played in an internet browser using the keyboard as the input device. The objective is to fly an aircraft as far as possible. During flight the player encounters the types of clouds that have been addressed in the text based instruction. Applying their knowledge about clouds and possible hazards, the players must decide to fly through a cloud, go over or under it, or land the aircraft to wait for the danger to pass. The impact of cloud hazards (i.e., icing, turbulence or lightning) on the aircraft is visualized on screen and results in increased fuel consumption. Consistent with reality, flying above a certain altitude requires oxygen. A limited supply of oxygen is available at the start of the game. During the game extra amounts of fuel and oxygen can be picked up to prolong the flight. The player may also encounter balloons and bird flocks. Colliding with these must be avoided, because this will immediately end the game. In all other cases the game will end when the player runs out of fuel or oxygen. The distance traveled by the aircraft translates into a game score. Picking up score boosters during flight adds to the score, while making unnecessary landings leads to a deduction of points.
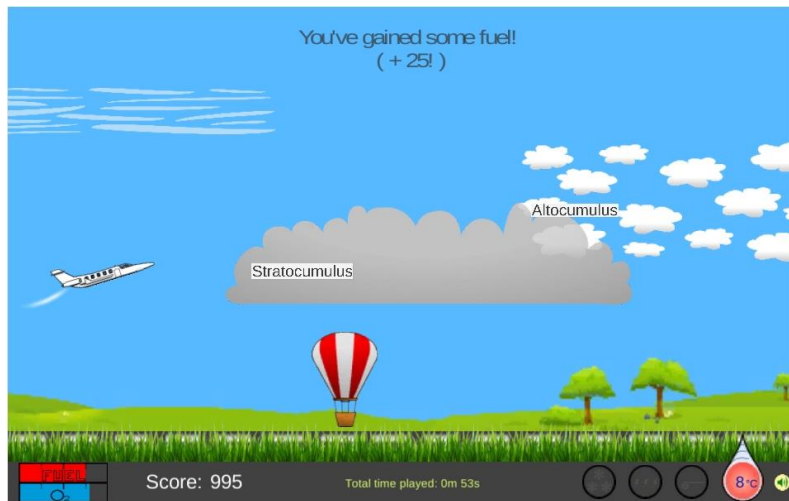

Fig. 2. Screenshot of the game

Tests. Participants studied the materials and played the game at their own pace and were free to proceed to the test when ready. Mandatory players had to play at least ten minutes for the test to become available. The test consisted of 11 knowledge questions and 7 application questions. In the knowledge questions participants were

asked to reproduce cloud characteristics and recognize clouds from drawings and photographs. In the application questions players had to apply their knowledge to a certain situation. For example, a picture was presented of an aircraft and a certain type of cloud, with a number of possible routes drawn in the picture (Fig. 3). Participants were asked to choose the best route, taking into consideration safety, comfort and efficiency. They were also asked to explain their reasons for choosing this specific answer. Application questions were assigned higher weights than knowledge questions. Test scores were calculated as the percentage of points earned of a maximum of 49 points.

After the test participants were presented with the post experiment questionnaire. This questionnaire solicited more information on prior knowledge and gaming preferences. The voluntary players were asked about the extent of the freedom of choice they experienced in choosing to play or not to play the game. The mandatory players were asked whether they would have played the game when given a choice. Upon completion of the test and the questionnaire, participants were informed about the follow-up and about their chance of winning the gift certificate.
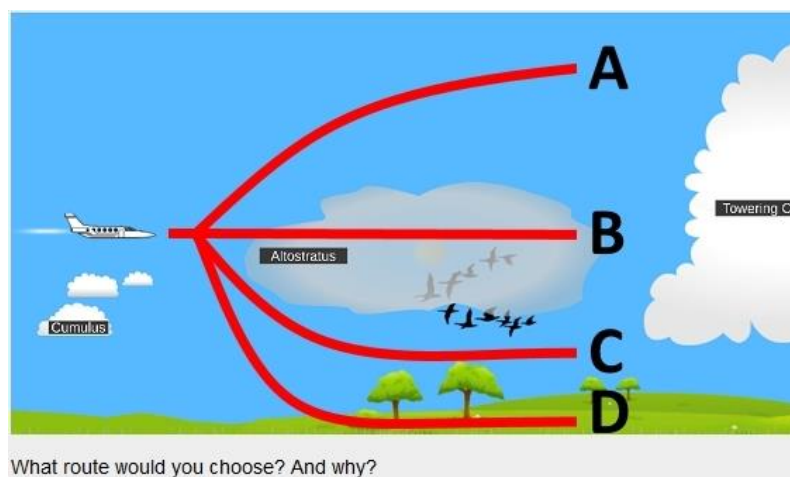

Fig. 3. Test Item: Application Question

4. Results

A total of 19 participants completed the experiment by taking the final test, 16 of them played the game. Game scores ranged from 721 to 4770, and test scores from 25 to 77. Table 1 shows the means and standard deviations on game and test scores. One-way analysis of variance controlled for motivation (ANCOVA) showed that there were no statistically significant differences in test scores and game scores between the groups.

Table 1. *Means and Standard Deviations for Voluntary and Mandatory Gameplay Groups*

	Test Group			
	Mandatory Gameplay (n=9)		Voluntary Gameplay (n=10)	
Measure	M	SD	M	SD
Gameplay (min)	16.8	8.2	3.4	2.9
Test score (%)	48.7	18.3	44.9	11.3
Game score	2723	1332	1092	1085

T-tests revealed that there were no significant differences in test score and game score between male and female participants. Nor was there a difference between gamers and non-gamers for test score. However, gamers did achieve a higher game score than non-gamers ($F(1,17) = 8.35$, $p < .01$). Participants aged 40 and below scored significantly higher in the game ($F(1,17) = 15.58$, $p < .01$) and on the test ($F(1,17) = 4.90$, $p < .05$) than participants over the age of 40.

The length of gameplay varied widely, as three participants chose not to play at all, while two participants played for more than half an hour. The number of tries varied from zero to 22. Table 1 reveals that mandatory players played an average of 13.4 minutes longer than voluntary players (One-way ANOVA: $F(1,17) = 23.50$, $p < .001$). There was a significant effect of gameplay type on the amount of time played using prior motivation as covariate, $F(1, 16) = 10.98$, $p < 0.01$.

A t-test revealed that there was no significant difference in length of gameplay between male and female players. Nor was there a difference between gamers and non-gamers. Females did however have a lower average time per game attempt ($F(1,14) = 5.90$, $p < .05$). Participants over the age of 40 also had a lower average time per attempt than younger participants ($F(1,14) = 4.64$, $p < .05$).

We expected to distinguish two subsets of players in both test groups: those who played only as long as required (up to 12 minutes) and those who continued playing (longer than 12 minutes). Table 3 shows the counts and percentages for these subsets. Within the voluntary group we also expected to find players who did not play at all and players that only played to get an idea of the game by playing three tries or less (Table 4).

Table 3. *Subsets in Mandatory and Voluntary Gameplay Groups*

		Gender		Gaming Interest	
		Male (n = 10)	Female (n = 9)	Non-Gamer (n = 11)	Gamer (n = 8)
Mandatory (n = 9)	Less than 12 minutes	1	2	2	1
	More than 12 minutes	5	1	2	4
Voluntary (n = 10)	Less than 12 minutes	4	6	7	3
	More than 12 minutes	0	0	0	0

Table 4. *Subsets in Voluntary Gameplay Group*

		Gender		Gaming Interest	
		Male (n = 10)	Female (n = 9)	Non-Gamer (n = 11)	Gamer (n = 8)
Less than 12 minutes (n = 10)	No play	2	1	3	0
	3 tries or less	2	2	2	2

After the test, participants were asked how much they had enjoyed playing the game on a scale from 1 to 10 (M = 6.56, SD = 1.55). There was no significant difference between the test groups or between male and female participants. Younger participants however enjoyed the game more than older participants ($F_{(1,17)}$ = 8.96, $p < .01$), and gamers enjoyed it more than non-gamers ($F_{(1,17)}$ = 5.49, $p < .05$).

Mandatory players were asked how they felt about being obligated to play the game for a minimum amount of time. In general participants were neutral about this (M = 2.11, SD = .78). They were also asked if they would play the game if they were given a choice. Almost 78% indicated they would. A correlation for the data revealed that the feeling about being obligated to play and the decision to play the game if not mandatory, were not significantly related, $r = .44$, $n = 9$, $p = .23$. A positive decision to play the game if it was not mandatory was not associated with a neutral or positive feeling about being obligated to play the game. Voluntary players were asked about the amount of freedom they experienced in choosing to play or not play the game on a scale from 1 to 10. The experienced levels of freedom ranged from 6 to 10, with a mean of 8.20 (SD = 1.69) and did not differ between gamers and non-gamers, male and female players or younger and older participants.

5. Discussion

Test scores. This study sought to investigate the impact of freedom to choose to play or not play a serious game on the learning effect of this game. The learning effect of the serious game was measured by a test taken shortly after the training. Although we expected voluntary players to perform better than mandatory players, a t-test failed to reveal any statistically significant difference in either direction. Participants in both groups scored equally on the test. This effect may have several causes, such as the learning effect of the game or the validity of the test. However, they cannot be determined within the current study.

Gameplay. The second aspect of interest was gameplay, measured in game score and duration. Contrary to our expectations voluntary players played for a shorter period of time than mandatory players and made less attempts. All voluntary players decided to quit playing the game within three minutes. This raises the question why. Apparently voluntary players were not engaged in the game, even though they rate the game about the same for enjoyment as the mandatory players do. Two thirds of the mandatory players play more than two minutes beyond the ten minute minimum,

showing that the game in fact can be engaging. Perhaps this indicates that a time requirement is beneficiary for gameplay, as it forces the participant not to give up at the first setback. The current data does not provide a conclusive explanation.

Motivation. In line with the findings of Fulton et al. [17] we expected freedom of choice to motivate voluntary players and encourage them to accomplish better results. Additionally it would be understandable for a mandatory player to have a negative feeling about the obligation to play.

However, voluntary players did not do better on the test, nor did they score higher on the level of enjoyment than mandatory players. Mandatory players reported a neutral feeling about having to play the game for a minimum amount of time, not a negative one. Possibly the fact that one participates voluntarily in the experiment changes the way one feels about an obligation to play the game. Alternatively these outcomes may possibly be caused by the limited number of participants or the game design. Further research is needed to clarify this.

Mandatory players even indicated that they would play the game if it was not mandatory. Although the following results were not significant with the number of participants in the current study, they do indicate an interesting trend. The percentage of mandatory players, who said they would play the game without the obligation, was higher than the percentage of voluntary players who actually did. The gameplay duration estimated by the mandatory players was also higher than the time played by the voluntary players.

Non-gamers. While the study focused on the differences between voluntary and mandatory players, some other results were found. Women and non-gamers played shorter and achieved lower scores than men and gamers respectively. This may be indicative of the general gaming skills of these groups. However, they did not perform worse on the test. These outcomes do not support the findings of Heeter et al. [14], who concluded that non-gamers are likely to be at a disadvantage in serious gaming. Also, the negative affect Heeter et al. found have not been established in the current study, despite the fact that non-gamers enjoyed the game less than gamers.

6. Limitations and future research

The group difference on prior motivation would probably not have occurred with a larger sample size or a different assignment strategy (pair matching). By recruiting through social media we aimed to reach a large number of participants, but in fact the number of participants was limited. From the 62 initial registrations, only 19 persons completed the experiment. This dropout rate may also have influenced the results. Also mandatory participation to the study (as part of a regular course) would be of interest as this would provide a normal motivation setting for students in which the effects of voluntary gameplay can be observed without self-selection issues.

7. Conclusion

This study aimed to determine whether and to what extent gameplay and learning effect of a serious game are affected by the freedom to choose to play or not play the game. We expected that using the game voluntarily as a learning tool would result in improved player performance in a test, in comparison to the results after mandatory gameplay. This result was not found. However, it was found that mandatory gameplay in the CloudAtlas game does not ruin the enjoyment and engagement in the game, which contradicts the assumption of many game design theorists and practitioners that games need to be played voluntarily in order to be engaging, fun, and effective.

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