“This game is girly!” Perceived enjoyment and student acceptance of edutainment

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Abstract. Serious video games that enable students to engage into topics as mathematics through an enjoyment process are becoming increasingly popular. However, there is lack of empirical evidence on the relationship between students’ enjoyment and their intention to use serious video games. This study is about a storytelling serious video game, which has the goal to improve the mathematical skills of players. The game has a plot, featuring a story in which a mission is assigned to the player. The story and the mission are used to stimulate the students’ interest and motivate them to play the game. The empirical study is a controlled experiment to which 46 Gymnasium (middle school) students participated. Results confirmed the positive effects of the enjoyment on students’ intention to use storytelling serious games. Notably, we found that gender has a moderating effect on the relationships between enjoyment and intention to use the game. The results of this study suggest that games with a storytelling component might be attractive to girls.

Keywords: Storytelling, Serious, Video Game, Enjoyment, Mathematics, Experiment

1 Introduction

Many authors argue that the growth of serious games has a large impact on learning procedures. Studies indicated that playing video games gives learners a ‘‘mental workout’’ and the structure of activities embedded in video games develops a number of cognitive skills [12]. The emergence of serious games has further facilitated the wide adoption of learner-centered education and other changes in educational practices. Video games have drawn significant attention from educational institutions and business organizations due to the potential educational and cost benefits; however, the introduction of video games in teaching is often complex, and learners do not always use them as expected [19]. For instance, difficulties in technology are some of the most widespread barriers for effective serious game adoption.

The purpose of the empirical experiment is to examine whether and how enjoyment affect learners' intention to use the storytelling serious video games. First we designed and developed a serious storytelling math game. The video game named "Gem-Game" and is targeted to children that attend first and second class of Gymnasium (middle school). Afterwards, we elaborated on an experimental procedure that includes surveys with constructs regarding students' enjoyment and intention to use the storytelling serious game. They played the game during a school hour, after which they completed the respective survey.

Despite that serious gaming is one of the main categories of entertainment computing, limited research exists concerning effect of entertainment characteristics of serious games on learners' intention to use these games. Our work is grounded in existing theoretical frameworks [7, 13], which propose the factor of enjoyment for understanding games.

This study is centered on two research hypotheses: about the relation between enjoyment (H1) and Intention to use serious games and how this relation is influenced (moderated) from student gender (H2) (Fig. 1).

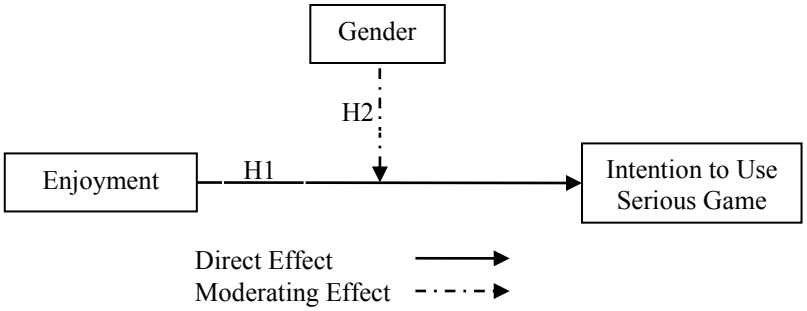

Fig. 1. Path Diagram of the research hypotheses

Strong empirical evidence indicates that the motivation basis of human decisions relies on the so-called approach system. The activation of this system results positive mental and cognitive states [3]. For the perspective of video games, player enjoyment is the most important goal. Enjoyment is deemed as a most appropriate measure of motivation because enjoyment measures how the game helps achieve the task related objectives. Venkatesh et al. [17] report that enjoyment (instruct motivation) has no direct effect on intention to use a system. However, the sense of enjoyment while the students learn through a serious game reduces anxiety and help students feel confident about their success. Therefore we hypothesize that:

H1. *Students' enjoyment has a positive effect on their intention to use serious storytelling game*

One of the most consistent results in studies of video games is the difference among boys and girls [13]. Some researchers (i.e. [1]) indicate that the difference rise from the fact that boys are more familiar and experienced with video games. Bruner et al., [5] mention that competition and violence may deter girls from playing video

games. Another study [4] reveals that females prefer puzzle, adventure and managerial games and males prefer sport, strategy and role playing games. These differences can be explained by the fact that girls and boys are differ systematically on neurocognitive tests relevant to the use of digital games [4]. In addition, males consider games as more useful learning tools because they accommodate to their neurocognitive propensities [6]. In view of the above, it can be assumed that the effect of enjoyment on students' intention to use serious games is differentiated among boys and girls. Therefore, the following hypothesis is formulated:

H2. *Students' gender has a significant moderating effect on the relationship between enjoyment and intention to use serious game.*

2 Methodology

2.1 The Game: Gem-Game

The main purpose of Gem-Game[1] is to improve the mathematical skills of players [10]. The main character (Peter) moves up or down dependent on the operation executed by the player. So the students also get a visual idea of increasing quantity when adding and decreasing quantity when subtracting.

Most notably, the game has a plot, featuring a story in which a mission is assigned to the player. The story and the mission are used to stimulate the students' interest and motivate them to play the game (fig. 2). The dialogues and the plot are funny, so that it does not resemble rigid book or common computer-based exercises.

According to Vogler [18] each storytelling game consists of some common stages; our game's design (Fig. 2) follows Vogler's storytelling structure. In the first stage, the hero is situated in the ordinary world; in our game the hero named Peter is in his bedroom and looking for his dog. Then the hero is presented with a problem or event that necessitates leaving the comfort of the ordinary world, Peter's dog, Lucky has been kidnapped. Next, the hero meets a mentor or someone who may offer advice or guidance, the fairy guides Peter to collect 30 diamonds. Once the hero commits to the adventure, he begins the problem-solving process. During this process, the hero encounters various challenges that must be overcome in order to progress. In this stage Peter has to play and win the game in order to collect the necessary diamonds (Fig. 3). When Peter collected the diamonds, the fairy is appeared, fairy called the witch, witch is appeared and gets the diamonds, release the dog and the moral aspect of the game is presented.

[1] Gem-Game: http://scratch.mit.edu/projects/geostam/1292162

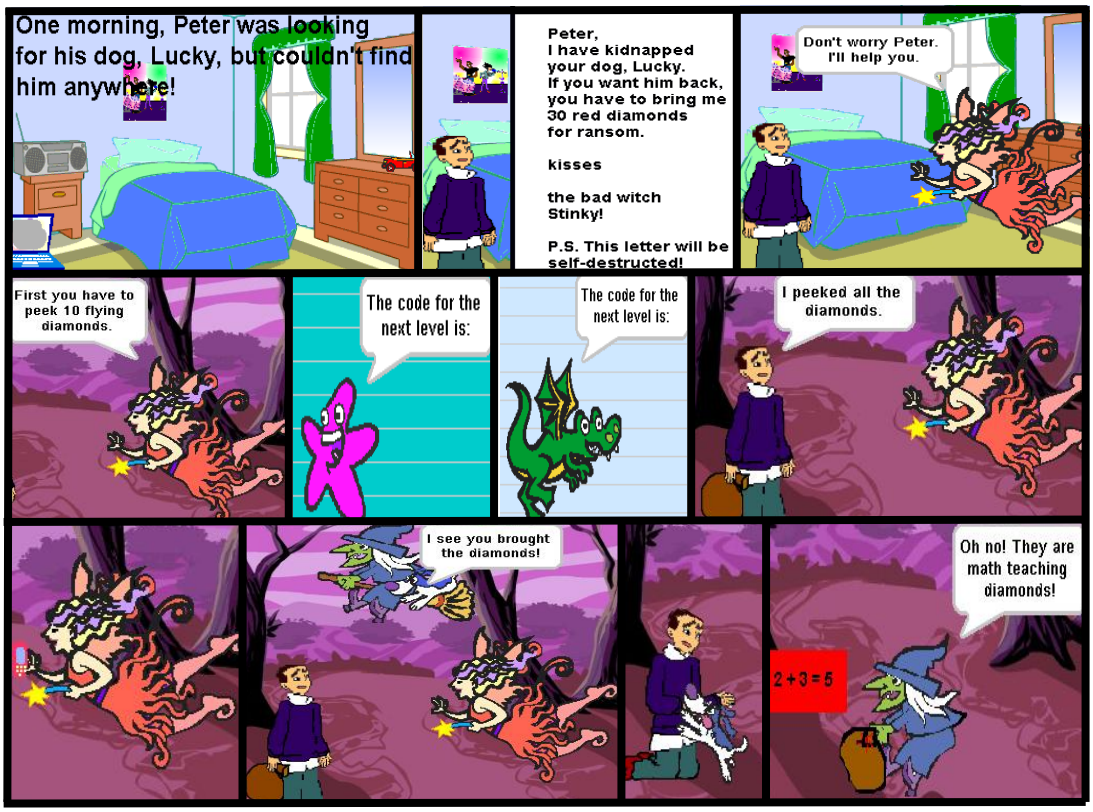

Fig. 2. Gem-Game Storytelling Structure

The ultimate goal of the player is to retrieve his dog by collecting diamonds. To achieve the ultimate goal, Peter must win the 3 stages (fig. 3). In particular, Peter must correctly add/subtract in order to earn diamonds. For example, if Peter is positioned on line 6, and the diamond is on line 1, the player must write -5 in order to gain the diamond. The player completes each stage by collecting 10 diamonds.

The first stage has only positive integers, the second stage has only negative integers, and the last stage has both positive and negative integers. Moreover, at each stage Peter wears a different uniform: a flyer uniform in the first stage; a diver uniform in second stage; and a helicopter uniform in the third stage.

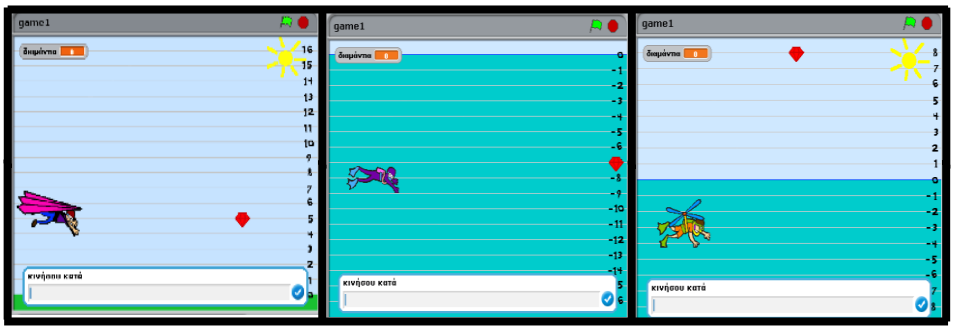

Fig. 3. Video game stages air (left), sea bed (center) and helicopter (right)

2.2 Sampling and Procedures

The sample of participants in this study was comprised of 46 students. Of the 46 participants, 29 were boys and 17 girls. All of the students who participated in the experiment were volunteers and around 13-14 years old, attended the second grade of gymnasium (middle school), and they were taught the same syllabus on mathematics and informatics. The experiment took place in a Greek state gymnasium. They played the game during a didactical hour, after which they completed the respective survey. The study was conducted over a weekly period from November 14–18, 2011. In addition, students played video games at school once a week for 4 weeks before the experiment in order to minimize the effect of students' enthusiasm. The game play was conducted on Windows desktops with a 17-inch screen using headsets.

2.3 Measures

After the game play, students completed a paper-based survey. The surveys gathered feedback of students' enrolment with the storytelling serious math game. The survey consisted of two factors adopted from prior studies (Table 1). The factors are enjoyment (ENJ) and Intention to Use Storytelling Serious Game (IUSSG). ENJ refers to the extent to which the activity of using a storytelling serious game is perceived to be personally enjoyable [15, 17], and IUSSG refers to the degree of students' willingness to play a storytelling serious game [9]. In both cases, 5-point Likert scales (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 5 = strongly agree) were used to measure the variables.

Table 1. The Research Factors and their Respective Items

Factors	Operational Definition	Items	Source
Enjoyment (ENJ)	The degree to which the activity of using a storytelling serious game is perceived to be personally enjoyable.	Studying is more interesting using Gem-Game (ENJ1).	[17]
		Using Gem-Game is fun (ENJ2).	
		I like using Gem-Game (ENJ3).	
		I enjoy those aspects of my studying that require me to use Gem-Game (ENJ4)	
Intention to Use Storytelling Serious Game (IUSSG)	The degree of students' willingness to play a storytelling serious game.	I plan to use Gem-Game for studying in the future (BI1).	[9]
		I intent to continue using Gem-Game for studying in the future (BI2).	
		I expect my use of Gem-Game to continue in the future (BI4).	

Except for the data provided by surveys, this study gathered information from conversation/interview with teachers and researchers' observations. These data provide a vehicle in order to interpret and validate the results in the Discussion and Conclusions section.

2.4 Data Analysis

The data were separated into two groups by performing median split on ENJ. Afterwards, an independent samples t-test was conducted in order to examine the effect of ENJ on students' IUSSG. In the next step, it was examined if students' gender influences the relationship between ENJ and students' IUSSG (H2). To test the moderating effect of students' gender, the correlation coefficient between ENJ and IUSSG of the males and females was tested by simple regression. Then, the coefficient R from the result of regression analysis and the sampling N was used to conduct Fisher's Z-transformation analysis.

3 Research Findings

Fornell and Larcker [8] proposed three procedures to assess the convergent validity of any measure in a study: (1) composite reliability of each construct, (2) item reliability of the measure, and (3) the average variance extracted (AVE).

First, we carried out an analysis of composite reliability and dimensionality to check the validity of the scale used in the survey. Regarding the reliability of the scales, Cronbach`s α indicators was applied and the results of the Cronbach's test

show acceptable indices of internal consistency in the three scales considered: ENJ (*0.91*), and IUSSG (*0.97*).

In the next stage, we evaluated the reliability of the measures. The reliability of an item was assessed by measuring its factor loading onto the underlying construct. Hair et al. [11] recommended a factor loading of 0.6 to be good indicator of validity at the item level. As Table 2 presents, all items exhibited factor loadings that were higher than 0.6, with no cross construct loadings, indicating good discriminant validity [11]. Consequently, it is possible to use a sole factor for representing each theoretical construct.

The third step for assessing the convergent validity is the average variance extracted (AVE); AVE measures the overall amount of variance that is attributed to the construct in relation to the amount of variance attributable to measurement error. Convergent validity is found to be adequate when the average variance extracted is equal or exceeds 0.50 [11].

Table 2. Summary of Measurement Scales

Factors	Items	Mean	S.D.	CR	Loadings	AVE
Enjoyment	ENJ1	4.05	2.39	0.91	0.87	0.66
	ENJ2	3.55	2.28		0.62	
	ENJ3	3.40	2.54		0.90	
	ENJ4	3.90	2.20		0.83	
Intention to Use Storytelling Serious Game	IUSG1	3.30	2.34	0.97	0.84	0.72
	IUSG2	3.00	2.29		0.87	
	IUSG3	2.70	2.00		0.84	

To examine the H1 hypothesis, the empirical data were divided into two groups based on the students' responses. We perform a median split on ENJ (*3.25*) and we used a t-test having the ENJ as an independent variable and the IUSSG as a dependent. As it can be seen from the outcome data in Table 3, ENJ exhibits a highly significant impact on IUSSG.

Table 3. Hypotheses testing using t-tests

Dependent Variable	**Mean (S.D.)**		T	Results
	Low	**High**		
IUSSG	Enjoyment (ENJ)			
	1.88 (1.36)	3.70 (2.33)	3.02*	H1 (Accepted)

* $p < 0.01$

The objective of this stage is to examine if students' gender influences the relationship between ENJ and IUSSG. To examine that moderating effect (H2), the correlation coefficient between ENJ and IUSSG of males and females students was used. The simple regression of males and females was conducted among ENJ and students IUSSG. Table 4 shows the R for the males and for the females at ENJ. Then, the coefficient R from the regression analyses and the sampling N was used to conduct a Fisher's Z-transformation analyses. The Fisher's Z-value of ENJ is $2.04 > 1.96$; the one-tailed test shows that the correlation coefficients are not significant at the 95%

significant level [2]. The results mean that these data provide strong evidence that learners' gender has a significant moderating effect on the relationship between ENJ and IUSSG (supporting H2).

Table 4. Testing the moderating effect of gender using Fisher's Z-transformation analysis

	Male (N=29)	Female (N=17)	Significance test (<1.96)	Results
ENJ→IUSSG				
Correlation coefficient R	.665*	.125*	2.04[a]	H2 (Accepted)

*Represents that coefficients are significant at 0.01 or above.
[a]The critical value for Z is 1.96 for $p < 0.05$.
ENJ, Enjoyment; STF, Satisfaction; HAP, Happiness; IUSSG, Intention to Use Storytelling Serious Game.

In fig. 4 we can clearly observe the moderating effect of gender on the relationship among ENJ and IUSSG, in addition boys with high ENJ have the same IUSSG with girls with low enjoyment, as such, enjoyment affects mostly boys.

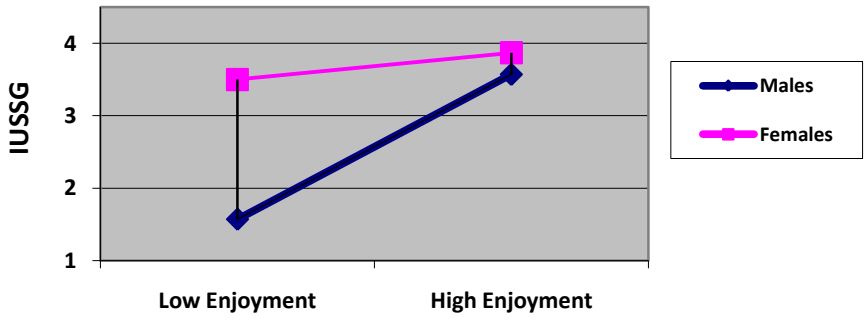

Fig. 4. The moderating effect of gender

4 Discussion and Conclusions

The main objective of the presented study is to explore the dependency between ENJ and IUSSG. In particular, the findings indicate that ENJ has a positive effect on students' IUSSG. Another conclusion of this study is the moderating effect of students' gender on the relationships between ENJ and IUSSG. An interesting discovery is observed; girls who are low enjoyed with the game have the same IUSSG with boys who are high enjoyed. This result can be possibly explained by the fact that boys are more familiar and experienced with video games [1], as such is more difficult to change their attitude (ENJ). But if you will change their attitude then they will reward it with their behavior.

The study has also produced a number of interesting qualitative findings that illustrate the impact of the entertainment nature of games on students' behavior. At the end of the study students suggested that they should even play on their own laptop in classroom, and they could even use it at home in order to study in this way. Another

crucial issue was students' sense during the experiment. Based on the researcher observation in the lab it can be presumed that most of the students felt "exited". Researchers' opinions regarding the "excitement" of the students arise from the comments of the students, such as "awesome," during and after the experiment. Teachers present were asked to observe students playing the game, but they were not actively involved. In particular, teachers thought that students who played the game seemed so immersed that their behavior changed, and they appeared to be very interested in the game. In general, the results counter positive emotions and beliefs for the use of serious game.

The survey findings revealed that girls affected less from enjoyment (Fig. 4). On the other hand boys are greatly affected as boys with low enjoyment are not likely to use the game. Serious game developers should strive to increase students' intrinsic motivations, and make them feel enjoyment. Especially for the case of boys, serious games must updated (e.g., characters, story-line), in order to meet the needs of today's students, as they are used to play state of the art games.

Although our study provides evidence for the serious games adoption and gender issues, there are also some limitations. Firstly, the subjects were secondary education students from Greece, but beliefs and perceptions may differ among countries. Secondly, self–report method (surveys) was used to measure research variables, so some of the results might have a common method biased. However, we eliminate that bias by interpreting the results with some qualitative methods (observations, light interviews). Third, other demographic variables (i.e., age, educational level) may have contingent effect on serious gaming, which limits the extent of the generalization to other populations.

Further studies should investigate the effect of entertainment attributes on students' actual performance, under different context and over longer periods. In addition, research is also needed to examine students' attitude and performance with latest technologies (Augmented-Mixed Reality, 3D games).

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