Investigating the Impact of Gaming Habits, Gender, and Age on the Effectiveness of an Educational Video Game: An Exploratory Study

Borja Manero, Javier Torrente, Clara Fernández-Vara, and
Baltasar Fernández-Manjón, *Senior Member, IEEE*

Abstract—This study examines the influence of players' age, gender, and gaming preferences and habits (from now on, "gaming preferences") on the effectiveness of a specific videogame that has been designed to increase the interest towards classical theater among teenagers. Using a validated instrument, participants were divided into four groups based on their gaming preferences: (1) Well-rounded (WR) gamers, who play all types of games often; (2) Hardcore players, who frequently tend to play first-person shooter (FPS) and sports games; (3) Casual players, who play moderately and tend to play music, social, and puzzle games; and (4) Non-gamers, who barely play videogames at all. Among all of the participants' personal factors (age, gender, and type of player) that were measured, only gaming preferences seemed to have a significant ($p < .05$) positive influence on students' interest in theater-going. Neither age nor gender seemed to affect the outcomes. Casual and Well-rounded gamers scored higher in the game than Non-gamers and Hardcore players. Due to these results, we also explored whether the gaming profile affected traditional educational approaches. Traditional education worked better than videogames only for students who do not usually play videogames. This study suggests that gaming preferences may influence the effectiveness of different educational approaches. Knowing students' gaming preferences in advance may help educators find the best educational approach for each student.

Index Terms—Computer uses in education, computers and society, learning technologies, educational videogames, applied games, digital humanities, videogames on arts

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1 INTRODUCTION

COMPUTER games have drawn significant attention from educational institutions and business organizations due to their educational and motivational potential [1], [2], [3], [4]. The connection between videogames and education is deeply rooted in commercial videogames, which have been proven to integrate learning principles in their designs, combined with challenges and other motivational devices, to help players learn how to play the game [5], [6], [7], [8], [9]. Those benefits have fostered the growth of educational videogames in the last few years, and this growth is heavily influencing both teaching and learning methods.

A growing number of researchers support the use of commercial videogames as learning experiences. One of the arguments is that the games' educational design often incorporates challenge, motivation and learning principles, which may improve traditional educational approaches [10]. It is assumed that educational videogames influence learning by changing cognitive processes and affecting

gamers' motivation. Beyond learning experiences, there are studies that already demonstrate how educational videogames can be used as motivational tools in different fields such as computer science [11], geography [12] and engineering [13], among others.

Despite these advantages, the introduction of games in education is still an open issue because the learning or motivational outcomes obtained often do not live up to the expectations generated [14]. This has led several authors to argue that the factors that influence outcomes of game-based learning should be thoroughly investigated, although little work has been done in this regard [15].

The present study explores some of the factors that could influence the outcomes when a motivation-driven educational videogame (for simplicity, from now on only educational videogame) is involved in the educational process.

1.1 Brief Description of the Previous Experiment

This paper is based on previous work led by the authors, an evaluation of the effectiveness in increasing the interest of high-school students in theater using the game *"La Dama Boba"*[1] *(The foolish lady)*. This is a point-and-click adventure game created for educational and motivational purposes [16] based on the homonymous theater play by Spanish playwright Lope de Vega [17] (See Fig. 1).

The decision to design the game as a point-and-click adventure was taken for several reasons: First, this genre

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- B. Manero and B. Fernández-Manjón are with Complutense University of Madrid, Madrid 28040, Spain.
  E-mail: borja@sip.ucm.es, balta@fdi.ucm.es.
- J. Torrente is with University College of London, London WC1E 6BT, United Kingdom. E-mail: jtorrente@e-ucm.es.
- C. Fernández-Vara is with the Game Center, New York University, NY 11201. E-mail: clarafervar@gmail.com.

1. Download the game from damaboba.e-ucm.es

Fig. 1. Screen capture of the game.

has strong underlying narrative underpinnings [18]. Second, graphical adventures are similar to theater plays [19]. Third, it aligns well with learning scenarios where problem-solving and critical and deductive reasoning are important [20]. Last, adventure games have the ability to engage students through an appealing story by creating empathy with characters [21].

All of the details of this experiment can be found in [22]. In the game used in that experiment, the player controlled the male protagonist of the theater play. The player went through the plot of the play solving situations that the character faced in the actual play. The main goal of the game was to increase interest towards classical theater.

The game was used alongside a traditional lecture given by the students' teacher, which served for comparison (quasi-experimental, pre-post). Students were randomly assigned to the game group or to the teacher group and invested the same amount of time in the activity (50 minutes). The teachers taught a class session on "The Foolish Lady" theater play as if it were part of their curriculum. All of the teaching materials used in the teacher group was provided by the researchers to help integrate the content and ensure that the same concepts were covered by both instructional approaches. The materials consisted of a set of presentation slides as back-up material to support their instruction. Students in the game group played the game La Dama Boba under the supervision of a researcher who did not provide any assistance but observed the students' interaction with the application. The students were allowed to play as many times as desired during the class.

The results showed that the increase of interest towards theater (which was the main goal of the videogame) was higher in the game group; we found statistically significant differences compared to the teacher group. However, these differences were not as large as expected. Overall, the game did not work as well as envisioned.

The researchers observed during the game play sessions that students in the game group showed different attitudes towards this motivational approach as opposed to the other group in the study. Some of the students seemed to be very engaged with the game and expressed enthusiasm about the idea of repeating the experience with different theater plays. Other students seemed highly distracted during the experience; their comments on the game after playing were mostly negative. This observation led us to conduct further analysis of the results, finding higher variability in the game group (Coefficient of variation = 32.69 percent) than in the teacher group. Whereas some students considerably increased their interest in theater, others students did not change their interest at all.

To sum up, the unexpected results obtained within the game group, along with the observations carried out during the experiment and higher variability of results in the game group, suggested that the game could have been more effective for some students and less effective for others. We set out to explore the personal factors that made the game more effective for some students than for others.

1.2 Goals and Research Questions

The purpose of this study is to perform an exploratory analysis of the collected data to get insight on the factors that may have resulted in the high dispersion and thus variable effectiveness observed in the game group. The factors that we took into consideration were personal attributes collected during the experiment: students' age, gender, and a short questionnaire (10 items) on students' gaming preferences and habits. "Gaming preferences and habits" (from now on, gaming preferences) is a proposed construct for characterizing a person's attitude towards digital games. This complex construct cannot be observed directly. In this paper, we will determine students' gaming preferences and habits by observing two indirect constructs: how often students play digital games and what types of games players enjoy the most.

In contrast to other factors that may influence the motivational outcomes through videogames, such as gender or age, gaming preferences cannot be directly measured. For each of these factors, we set a different research question, as follows:

1. Research question 1 (RQ1): Does the age of the students influence the effectiveness of an educational videogame in increasing students' motivation towards theater?
    Our target population consisted of high-school students pooled from a small age range (11-16); therefore, we expected that age would not affect our motivational outcomes.

2. Research question 2 (RQ2): Does the gender of the students influence the effectiveness of an educational videogame in increasing students' motivation towards theater?
    Existing studies suggest that gender is an important factor in game-based learning; thus, we hypothesized that gender will affect the effectiveness of our motivation-driven game.

3. Research question 3 (RQ3): Do gaming preferences of the students influence the effectiveness of an educational videogame in increasing students' motivation towards theater?
    It is reasonable to think that if a game belongs to a specific genre (e.g., adventure games, shooters, etc.) that students already enjoy, it is likely to be more effective. This led us to hypothesize that users' gaming preferences affect the effectiveness of the game.

This paper is structured as follows: the next section outlines the literature review. Section 3 presents the methodology and instruments followed to answer the research questions. Section 4 includes the results obtained. Section 5 provides answers to the research questions based on the results. Section 6 discusses the limitations of the study, and Section 7 presents the conclusions and closing remarks.

2   LITERATURE REVIEW

As mentioned in the introduction, the literature on the effectiveness of educational games is not consistent [23], [24], [25], showing both successful stories and cases where the outcomes did not live up to the expectations. It seems clear that educational games' implementation in the classrooms have yielded mixed results.

Because "La Dama Boba" game is a point-and-click adventure game, in this section, we want to show some of the studies that have addressed the effectiveness of the videogames and how personal factors could have affected this effectiveness.

Most of the studies carried out on educational videogames focus on learning performance. However, some studies draw attention to their enormous motivational potential. Researchers have reported how educational videogames can enhance students' interest [26], [27], [28], [29] and increase their learning motivation [30], [31]. Some researchers [32], [33] have argued that a well-designed educational computer game could provide a rich-resource environment with challenging educational missions to foster students' motivation and higher order knowledge. One of the best examples of a videogame used as a motivational tool was Tomb Raider. It was released in 1996, and 5 years later, the film adaptation resulted in a blockbuster mainly due to its videogame's fans.

Either as motivational or learning tools, what does seem clear is that to make a more powerful use of educational videogames, we need a better understanding of the factors that affect their effectiveness [34]. However, this issue contrasts with the research conducted so far, which has unevenly focused on measuring whether games are effective, instead of understanding *why* they are effective [35].

In the next section, we discuss the literature that examines the influence of gender and gaming preferences on digital game play outcomes.

2.1   Personal Factors Affecting Educational Videogames' Performance

Most of the studies regarding how personal factors affect the effectiveness of a videogame are focused on their learning capabilities. Videogames' motivational skills are less explored, and studies addressing how personal factors affect these motivational skills are mostly focused on players' gender. However, we have to note the study of Koivisto et al. [36], in which the effects of gender, age, and time using a game service were investigated.

2.1.1   Gender

Some researchers have studied how gender affects the learning performance of players [37], [38], [39], [40], finding significant differences between male and female players. However,

results are not consistent because different groups may obtain varying results.

This may be due to the different attitudes that male and female players adopt toward gaming, which are clearly disparate. For example, some researchers have found evidence that player motivations to play certain types of digital games are driven by gender. Inal & Cagiltay [41] reported that male players prefer games that include challenge, complexity and competition, whereas female players prefer to emphasize the importance of narrative and storytelling in games. Hoffman and Nadelson [42] argued that when an orientation to gaming was at stake, males were much more motivated to play videogames and to play for longer than females. Female players preferred socialization to the achievements offered in video game worlds.

Some studies have yielded evidence that males and females tend to prefer different types of video games [43], [44]. Chou and Tsai [39] found that males prefer playing sports and car racing games, as well as those including competition and action, whereas females prefer adventure games, puzzles or card games. Males and females also presented different attitudes towards videogames: male students were more likely to agree on positive statements about the effects of playing computer games (e.g., increased creativity, eye-hand coordination, personal relationships), whereas female students agreed on negative statements (e.g., aggressive behaviors). Kinzie and Joseph [45] researched middle school students' game activity preferences (similar to learning strategies) to make videogames more appealing and engaging to middle school students. Moreover, according to Steiner [46], the realization of gender-based adaptation in games will have enhancing effects on both students' motivation and learning performance.

2.1.2   Gaming Preferences

As we have just seen, the literature has reported some evidence on how genre affects the outcomes of educational videogames [39], [40], [41], [44], [45], [46]. However, taking into account the different attitudes and preferences toward gaming observed between male and female players, it is unclear whether the actual cause for disparate outcomes is gender or the students' attitudes toward game play. To the best of our knowledge, there are no studies about how gaming preferences affect either motivational or learning performance using educational games, which may help shed new light into this discussion. The hypothesis that gaming preferences may be a factor influencing digital game play outcomes instead of gender is plausible because there seems to be a relationship between game preferences and personality traits [47]. In addition, there seems to be a relation between game genres and the in-game learning strategies used. Hamlen [48] conducted an experiment examining the relationships between the videogame genres that children choose to play and the learning strategies that they employ to improve at these games. Her results showed significant correlations between videogame genres and learning strategies in two of the six learning strategies analyzed. Children playing action games were more likely to use repetition to learn, whereas children playing adventure games were more likely to use their imagination to take on the role of

the character in the game and think the way the character would to make decisions in the game.

2.2 Creating Gamers' Profile based on Their Gaming Preferences

As we stated in the Introduction section, gaming preferences cannot be directly measured. One of the most common ways to approach this has been to categorize players into different groups. Whereas authors such as Bartle [49] or Bateman and Boon [50] have approached gamer classification from an intrinsic perspective, building on the different aspects that motivate gamers to play, the most common approach is extrinsic, classifying gamers by describing their habits and preferences as the habits and preferences are observed.

In this line, there have been multiple attempts to classify gamers through different conceptualizations. Some works are rooted in the videogame industry and tend to classify gamers according to their purchasing habits, whereas other works are grounded in academia [47], [51], [52], [53], [54], [55], [56], [57]. Duchenaut, for example, used *World of Warcraft* to classify users according to their gaming experience, such as how long users play, what types of characters users prefer, etc. Lindley highlights what he called *orthogonal taxonomies* to avoid a simple hierarchical system of categories and subcategories and allow design concerns to be separated. In spite of all of these classification efforts, the most popular way to group games has been by genre, which involves clustering according to common gameplay features.

Mulligan and Patrovsky [58] proposed a three-level classification for online gamers: hard-core, moderate, and mass-market. In this case, moderate gamers stood between hardcore and mass-market (casual) and tended to spend quite a bit of money on games but not get as involved as hardcore gamers. According to Bateman and Boon [50], the audience model of Electronic Arts (one of the largest videogame publishers worldwide) was actually very similar to the one introduced by Mulligan and Patrovsky. Electronic Arts, however, referred to the moderate segment with the term Cool Gamers.

Despite the efforts to reach a solid classification of players, there is no consensus on this topic. Nevertheless, most classifications make the distinction between hardcore and casual gamers. In "A casual revolution", Jesper Juul [59] identifies hardcore players as people who play as a lifestyle preference and invest substantial amounts of time and money on games. In contrast, casual players tend to do the opposite, choosing games that adapt to their lifestyle, usually playing in platforms that they already own, and choosing games that can be played in short sessions in between other activities. It is common to think that hardcore players play more and are more game-literate; Juul reveals [59] that casual players also look for challenge in their games, accompanied by audiovisual rewards, and can also play for a long time, although the time is split up in short sessions. A reference to hardcore and casual can be found in most of the game design books [60].

3 METHODOLOGY

In this section, we describe the methods and instruments used (Section 3.3) and the participants analyzed (Section 3.1). In addition, a short overall summary of the methodology and the educational intervention (Section 3.2) are provided to improve the readability of the paper.

3.1 Population

The previous study that this paper is based on (see Section 1.1) involved 603 students, with $N = 530$ of them valid for analysis, adding up both game ($N = 325$) and teacher groups ($N = 205$). In the present study, the research questions are focused on the game group, and the teacher group is only used as a control group for RQ3.

These students came from 8 different schools in Madrid. An invitation email was sent out to more than 20 schools, and 14 accepted the invitation. Eight of them were selected: 3 private or chartered (38.8 percent of the participants) and 5 public (61.2 percent of the participants). This provides a representative sample of the educational system in the Madrid region: 65.9 percent public, 34.1 percent private or chartered schools [61]. The schools selected were also representative in terms of the socioeconomic status of the students for the Madrid region.

Most of the students in one of the schools could not complete the activities planned due to an unexpected power outage. To avoid potential bias, this school was excluded from any further analysis. Nine more students of different schools were also removed because the students experienced technical problems that prevented them from participating in the session.

Students were aged 11 to 18 and were attending the first four years of high school (junior high school). Students above age 16 (16 individuals, 2.65 percent) had repeated one or more academic years, a standard practice in Spain for underperforming students. Those students were included in the activity to avoid discrimination; however, they were not the target population and were removed from the experiment.

Our final sample involved 530 individuals, 87.89 percent of the total population: 325 students in the game group and 205 in the teacher's group. The age of our final sample ranged from 11 to 16 years old, and the median age was 14. The gender ratio in our sample was 54.9 percent males and 45.1 percent females. The gender ratio for high-school students in the Madrid region is currently 51.3 percent males and 48.7 percent females [61].

3.2 Educational Intervention and Research Design

A mixed experimental design was followed whereby researchers conducted pre-tests and post-tests to estimate the effect of playing the video game on the students' interest (within-subjects factor) towards theater. It is important to note that in this paper the teacher's group is only used as a control group regarding RQ3 (gaming profile). Concerning RQ's 1 and 2, only the game group, which is our main focus, will be tackled. The previous research design was extended to further compare results between subgroups of students (see Fig. 2).

Along with age and gender, we used a Game Preferences Questionnaire (GPQ) [62] to classify students into four disjoint profiles of gamers. From now on, we refer to the variable storing the profile of each student as *gaming profile*.
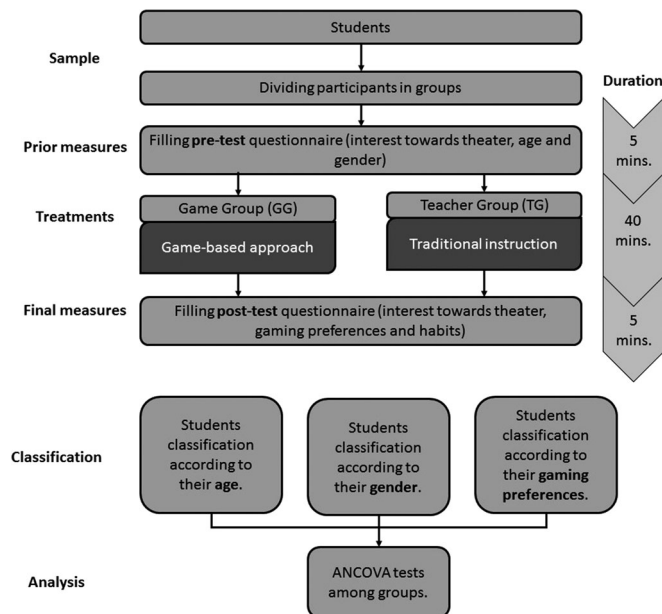
Fig. 2. Graphical representation of the previous research design that this paper is based on including players' classification and data analysis.

The procedure that was followed and the gaming profile classification obtained are described in full detail in Section 3.3.3. However, a short description of the four groups is provided next for the convenience of the diagonal reader. These four groups are described as follows:

- **Well-rounded (WR) gamers**: students who choose to play a diverse range of games and play considerably more often than average.
- **Hardcore gamers**: group of students that play more often than average but play mostly action games such as first-person shooters and sports games.
- **Casual gamers**: play music, social and puzzle games moderately.
- **Non-gamers**: group of students that play significantly less often than average. When they play, they do not seem to focus on any particular genre.

Next, we ran a one-way ANOVA analysis for I (Interest towards theater) pre-test scores to compare the starting points for each independent variable (age, gender, gaming profile). The results showed that there were statistically significant differences in the pre-test's scores for age, gender, and gaming cluster (age: $F = 2.50, p < .05$; gender: $F = 18.41, p < .05$; gaming cluster: $F = 12.10, p < .05$) among the three groups.

The differences among the pre-test scores led us to use an analysis of covariance (ANCOVA) to analyze the effect of the independent variables (age, gender, and gaming profile) on the dependent variable I (Interest towards theater) [63], excluding the differences in the students' pre-test scores (used as a covariate).

3.3 Measures and Instruments

Pre- and post-activity surveys included an instrument to measure the interest toward theater (ITT), which is described in Section 3.3.1. The initial survey contained some questions to collect personal factors – age, gender and school – and the 10-item Game Preferences Questionnaire described in Section 3.3.2.

3.3.1 Measuring of Interest towards Theater (ITT)

In this experiment, the students' interest toward theater (dependent variable) was measured using a self-developed scale composed of three 7-point Likert items:

- Rate from 1 to 7 how much you'd like to go see a classic theater play (1 = Not at all; 7 = Very much)
- Rate from 1 to 7 how much you like theater (1 = Not at all; 7 = Very much)
- Rate from 1 to 7 how much you would like to see the "La Dama Boba" theater play (1 = Not at all; 7 = Very much)

The resulting scale provides a total score ranging from 3 to 21.

The internal consistency of the scale used for student interest in theater play (ITT) was measured using Cronbach's Alpha test [64], resulting in 0.785 for ITT in the pre-test, 0.850 in the post-test. Cronbach's Alpha test could not be used in the other instruments because of their nature.

3.3.2 GPQ: Instrument to Measure Gaming Preferences

GPQ is consistent with the literature described in Section 2.3. It has in total 10 items on a 1-7 Likert scale. The full instrument is provided in Annex A, which can be found on the Computer Society Digital Library at http://doi.ieeecomputersociety.org/10.1109/TLT.2016.2572702. For a detailed validation of the instrument, please refer to [62].

The first item covers the subjective perception of gameplay frequency (FR). Items 2-10 address how much students liked 9 game genres, following the scheme proposed by Lucas and Sherry [65]. This classification is also consistent with previous research [57], [66] and accepted industry taxonomies. However, game classifications have been criticized for being inherently ambiguous and subjective, potentially leading to increased bias. To address this challenge, game genres are illustrated with appropriate examples selected jointly by the teachers and the research team.

The list of game genres included in GPQ (see Annex A, available in the online supplemental material): **First-person Shooters**, **Adventure games, Music and dance games**, **Social interaction casual games**, **Thinking and problem-solving games**, **Sports and racing games**, **Massively multiplayer online games**, **Fighting games,** and **Strategy games**.

We examined the construct validity of GPQ instrument through confirmatory factor analysis.

First, we carried out a Principal Component Analysis (PCA) [67] that revealed two components with eigenvalues >1.00 and that explained 33.85 percent and 20.95 percent of the total variance, respectively. Based on the visual inspection of the scree plot, two components were retained. We employed a Direct Oblimin rotation to aid interpretability. The rotated solution exhibited met Thurstone's criteria for simple structure [68]. The interpretation of the data was consistent with the attributes of the questionnaire and current state of the art, which suggest the existence of two different components related to gaming preferences, thus echoing the casual versus hardcore division. The pattern matrix and communalities of the rotated solution showed that adventure games, FPSs, fight, sport, and internet collaborative games, as well as gaming frequency, were strongly

TABLE 1
ANOVA Results on the Pre-Tests

Independent variable	One-way ANOVAs on Pre-Test			
	N	df	F	p
Age	325	5	2.5	.031
Gender	325	1	18.41	<.005
Gaming Profile	325	3	12.10	<.005

TABLE 2
Tests Scores and ANCOVA Results by Age, Gender,
and Gaming Profile (Game Group)

Independent variable	ANCOVAs on Post-Test				
	N	df	F	p	Partial η^2
Age	325	5	1.16	.33	.018
Gender	325	1	2.95	.087	.009
Gaming Profile	325	3	2.78	.041*	.025

*$p < 0.05$.

represented by component 1, whereas component 2 represented social, thinking and musical games. Strategy game habits seemed to be hardly predictable by two-component reduction. The correlation between the two components was positive and statistically significant [62].

3.3.3. Construction of the Gaming Profile Variable from Gaming Preferences

After reducing the number of components from 10 to 2, we applied a K-means clustering algorithm [69] to generate a variable gaming profile that allowed us to classify users in different categories based on their gaming preferences. In essence, the algorithm partitions N cases into k clusters or groups. Iteratively, each case is assigned to the group with the nearest centroid (vector formed with the mean of each variable used as input), serving as a prototype of the cluster.

The algorithm does not make any assumption on the number of clusters (k) to use – that choice is left to the researcher. Our decision took into account the existing literature (which usually considers from 3 to 5 types of players) and the turning point location criteria, which advises selecting the k that minimizes information loss while keeping compression as high as possible (minimum number of clusters) [70]. We adopted the four-cluster classification because it seemed to reflect the spectrum of gamers more accurately and the boundaries of the groups were easier to describe and explain than the boundaries for 3 of 5 clusters.

Next, we describe the characteristics of each cluster obtained (gaming profile), as shown by a descriptive analysis:

3.3.4 Casual Players

The first group played with average frequency [Cluster Median (CM) = 4 compared to the General Median (GM) = 4] and prefer Social (CM = 6; GM = 5), Musical (CM = 5; GM = 4), and Puzzle Games (CM = 4; GM = 3). This description fit with what is commonly known about the **Casual player.**

3.3.5 Well-Rounded Gamers

This group played more frequently than the average (CM = 6; GM = 4) in almost every type of videogame included in the instrument, with FPS games (CM = 6; GM = 4), Fighting (CM = 5; GM = 3) and Strategy games (CM = 6; GM = 4) predominant. We named this group the **Well-rounded** gamers.

3.3.6 Hardcore Players

The third group played frequently (CM = 5; GM = 4), mostly FPS(CM = 6; GM = 4) and Sports Games (CM = 6; GM = 5). They did not like other types of games. This description fit with what is commonly known about **Hardcore players.**

3.3.7 Non-Gamers

The last group did not usually (CM = 2; GM = 4) play videogames, so we labeled this group the **Non-gamers.**

4 RESULTS

One-way ANOVA showed statistically significant differences on the pre-test scores of the dependent variable (interest towards classical theater, ITT) across groups for all three independent variables (see Table 1).

Therefore, an ANCOVA was applied to evaluate differences in the post-test score using the pre-test score as a covariate. Standard preliminary checks were conducted to confirm that there was no violation of the assumptions of normality, linearity, homogeneity of variances and homogeneity of regression slopes [71].

RQ1. Does the age of the students influence the effectiveness of an educational videogame in increasing students' motivation?

ANCOVA [between-subjects factor: age (11 to 16); covariate: pre-test scores] revealed no main effects of age $F (5, 325) = 1.16$, p = .33, η_p = .018 (see Table 2).

RQ2. Does the gender of the students influence the effectiveness of an educational videogame in increasing students' motivation?

A second ANCOVA [between-subjects factor: gender (male, female); covariate: pre-test scores] also showed no main effects on gender $F (1, 325) = 2.95$, p = .087, η_p = .009 (Table 2).

RQ3. Do gaming preferences of the students influence the effectiveness of an educational videogame in increasing students' motivation?

However, ANCOVA [between-subjects factor: gaming profile (4 clusters); covariate: pre-test scores] revealed main effects of gaming profile $F(3, 325) = 2.880$, p = .041, and a small η_p = .025 (Table 2). A Bonferroni post-hoc analysis (pairwise comparisons) showed that the difference between the Casual and Hardcore groups was statistically significant and also the largest difference (Adj. Means difference: .99; p = .025) (Table 3).

These results showed that the game created more interest in theater for students in Casual and Well-rounded gamers groups than in Hardcore and Non-gamer students. This led us to question whether a similar trend could be observed in students that were exposed to traditional education (teacher lecture).

Effectiveness of the teacher's lecture according to gaming profiles.

To answer this question, we ran a similar ANCOVA on the students that attended the lecture [between-subjects

TABLE 3
Adjusted Means by Age, Gender, and
Gaming Profile (Game Group)

Ind. Variable	Values	N	ANCOVA	
			Adj. Mean*	Std. Err.
Age	11	5	12.11	1.11
	12	67	13.73	.303
	13	54	12.85	.33
	14	124	13.21	.221
	15	45	12.89	.37
	16	30	13.26	.45
Gender	Female	170	13.45	.2
	Male	155	12.97	.19
Gaming Profile	Casual	170	13.62**	.25
	Non-gamer	64	12.95	.31
	WR gamer	78	13.47	.28
	Hardcore	83	12.63**	.28

*Adjusted mean using pre-test scores as covariate.
** Significant differences between Casual and Hardcore: $p = .025$.

factor: gaming profile (4 clusters); covariate: pre-test scores], which revealed main effects of gaming profile $F_{(3, 205)} = 4.27, p = .003$, and intermediate partial $\eta_p = .068$ (see Table 4). Unlike the game group, **the teacher's lecture worked better for Non-gamers (Adj. Mean $= 12.94$) than for any other type of player.** At the other end, hardcore players scored the worst (Adj. Mean $= 11.06$). A post-hoc pairwise comparison (Bonferroni) showed that the biggest difference between Non-gamers and Hardcore groups (Adj. Means difference: $1.88; p = .003$) was the only statistically significant difference.

5   DISCUSSION

In this section, we interpret the results and interpret how these help answer the research questions defined in Section 1.2.

5.1   RQ1. "Does the Age of the Students Influence the Effectiveness of an Educational Videogame to Increase Students' Motivation?"

No. As we hypothesized, our results showed no evidence that age affects the videogame's effectiveness. We are aware that some authors argue that learners' age is one of the parameters influencing the effectiveness of videogames [72], [73]. That is not our case, perhaps because our videogame was specially conceived for teenagers and the students who participated in the study fit the intended audience (their age ranged from 11 to 16).

5.2   RQ2. "Does the Gender of the Students Influence the Effectiveness of an Educational Videogame to Increase Students' Motivation?"

In light of the ANCOVA results, we cannot claim that gender affected the effectiveness of "La Dama Boba" game in increasing interest towards theater, though females showed a higher Adjusted Mean (13.45) than males (12.97) (Table 3). Therefore, surprisingly, gender was not found to be a factor that influences outcomes – or at least the evidence collected did not allow for accepting that hypothesis. This is not consistent with previous studies that have shown differences in the effectiveness of educational games between males and

females [18], [74], [75], which may be explained by the particular game genre chosen (point-and-click adventures), which usually appeal more to females than to males.

Qualitative data collected through observation indicates that males and females play in very different ways. In most cases, male players tended to finish the game earlier but performed worse than females. They also showed different game play strategies. Male players tended to explore the game world without considering the potential effects of their actions beforehand, whereas females planned their moves more thoroughly and read the texts carefully. These observations are consistent with the various studies that analyzed the effect of gender on educational game play that were described in Section 2 [15], [46], [76].

We want to emphasize that those observed differences may be a consequence of a moderator factor, such as preferences on game genres because adventure games are usually preferred by females. In addition, reading skills, which are usually better in female students at that age, could have influenced the results because the game evaluated makes intensive use of dialogue and other types of texts.

Considering both the ANCOVA results and the observational evidence collected, it is hard to reject this hypothesis – future research should examine this issue to enable further discussion.

5.3   RQ3. "Do Gaming Preferences of the Students Influence the Effectiveness of an Educational Videogame to Increase Students' Motivation?"

Yes. Our results support our hypothesis that gaming profiles, created from a selection of questions about students' gaming preferences, affected the interest towards theater raised by playing the "La Dama Boba" game. However, for the game group, the η_p^2 value of .025 indicates a small-to-intermediate effect size, implying that the gaming profile affects the effectiveness of the game in a moderate way.

As shown in Table 3, the game worked better for Casual gamers (Adj. mean $= 13.62$) and Well-rounded gamers (13.47) than for Non-gamers (12.95) and Hardcore players (12.63). This could be due to the nature of the game itself (a point-and-click adventure game), a genre closer to what Casual gamers tend to prefer. Hardcore gamers do not have point-and-click adventure games among their preferences, which may decrease the effectiveness of the game for this profile. These results show that the game's efficiency is directly related to whether the game genre is included or not among the player's gaming preferences. In light of these results, this seems to be the most plausible explanation for the high variability observed in the game group because Casual and Well-rounded gamers outperformed Non-gamers and Hardcore gamers.

Interestingly, the gaming profile also influenced the outcomes of the teacher's group (traditional education). The teacher's lecture was more effective for those who were not interested in videogames (Adj. Mean $= 12.94$), whereas the scores were much lower for the rest of the groups. In fact, this group presents a much higher η_p value (.068), which implies an intermediate-to-large effect size.

Traditional education only worked better than the game for those students who did not usually play videogames (Non-gamers group). According to various studies,

TABLE 4
Tests Scores and ANCOVA Results by
Gaming Profile (Teacher Group)

GamingProfile	N	ANCOVA				
		Adj. Mean	Std. Error	F	p	Partial η^2
Casual	45	11.81	.40	4.85*	.003	.068
Non-gamer	42	12.94**	.39			
WR gamer	46	11.96	.38			
Hardcore	72	11.06**	.30			
TOTAL	205					

*$p < 0.05$
**Significant differences between Non-gamers and Hardcore: $p = .003$.

Non-gamers currently represent a minority among the students in developed countries [77], [78]. Therefore, our results suggest that traditional education could improve its overall results by increasing the use of videogames in the classroom, as argued by Gee [79] and Lacasa [9] among other authors.

This finding suggests that the students' gaming profile, created from their gaming preferences, can affect the motivational effectiveness of both game-based and non-game-based education. Although further research is required to delve into such a complex issue, it may be interesting for educational organizations (e.g., schools) to research their students' gaming profiles to improve their results.

6 LIMITATIONS

This study presents a series of limitations that should be discussed. First, the data analyzed were collected for a previous study (see Section 1.1) [22] with a completely different purpose. This constrains the depth of the analysis and, to some extent, the reliability of the conclusions inferred because the input data were not fully aligned with the research questions that this study aimed to answer. Second, our study was conducted in a very specific context (i.e., high-school students, improving interest towards theater) and in a short-term intervention, making results difficult to generalize. A long-term intervention with a follow-up test would have provided more insight into the effects of the gaming profile on student motivation towards theater.

The methods and instruments used were also limited. Our methods followed a quasi-experimental design, trying to isolate the effects of the educational approaches under study. Although this helps establish a fair quantitative comparison, especially when access to students cannot be prolonged over time, it can also introduce bias in the analysis of the data collected because the educational context is not fully taken into account [80]. Moreover, we found no fully validated instruments for this particular purpose and target population, so we developed our own. These instruments are composed of a small number of items (3-4), and produce measures on a small scale, which makes analysis of the size of the effect more difficult. Moreover, students were exposed to instruction for a short time (40 mins), which may have prevented certain effects from becoming fully observable. It would be interesting to push this research forward using refined and fully validated modifications of the instruments and longer instruction exposure times to see if other significant differences arise. Further studies should also combine more qualitative data (e.g., interviews with

the students and the teachers involved) to expand our knowledge on how gender and gaming preferences influence outcomes of educational videogames.

We are also aware that factorial ANCOVA analysis (instead of three separate ANCOVAs) would have allowed a more parsimonious analytic technique to investigate both the main effects and interaction effects.

However, the uneven distribution of the population between groups made this analysis unreliable: we did not comply with the linearity assumptions between the dependent variable and the covariate between groups.

Our study may also have been affected by the Hawthorne effect—the observed increase in students' performance may have been influenced by the novelty introduced by the game approach [81], leading to bias.

The teacher expectancy effect [82] may be another source of bias because teachers usually desire their students to show high performance when external observers are present, and the enhanced expectations may be passed onto the students and affect their actual performance.

7 CONCLUSIONS

The main purpose of this study is to explore the factors (age, gender or gaming profile) that affect the educational outcomes produced by a videogame designed to improve the interest in theater among high-school students. The results indicate that the gaming profile is the only factor affecting the interest in theater generated by playing "La Dama Boba".

In addition, the gaming profile also influenced the effectiveness of the traditional education (usual teacher). This influence was even stronger than the effect found within the game group.

The present study opens up the possibility of dynamically tailoring videogames to students according to their gaming preferences and will be discussed in forthcoming work. These could entail the following benefits for educational games design and research:

First, because the videogame industry already tailors their products to specific types of players and know who their market is, educational games should also take into account who the players will be to appeal to and reach them. Classifying the target population based on their gaming preferences could provide game designers with some hints of what type of game should be created. For example, a designer could reinforce the storytelling aspects and facilitate slow-paced gameplay if most of the population lies within the Casual cluster; or add faster action-based elements for an audience of Hardcore gamers.

Second, depending on the students' gaming profile, a game could be made more flexible by catering to different gameplay styles. As an example, a point-and-click adventure game could show more text to casual or no-gamers, whereas hardcore or well-rounded gamers' experience could be based on active mini games. Game pace, plot, dialogue, cut scenes or puzzles may be used differently according to the students' gaming profile, offering them a more tailored experience.

Finally, educational videogames researchers could use gaming profile information to obtain a more accurate insight on their populations. Depending on the type of the game that they use and their population traits, the results may vary significantly.

Interestingly, this study showed that the gaming profile influences motivational outcomes both in traditional and game-based education. This finding, which can be accounted for because gaming preferences are a factor directly related to personality, as Zammitto suggests [83], opens up a new field of possibilities.

Researching the gaming profile of students' populations could help educational designers make motivational experiences that better suit the tastes and styles of learning of the intended audience. How the gaming profile affects the learning outcomes is still an open issue, but we believe that educational game designers could also benefit from being aware of the students' gaming profiles because this could help tailor the games to the intended audience.

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Borja Manero Iglesias received the bachelor's degrees in physics (major in computer science) in 1999 from UCM (1999) and in dramatic arts (2007). Currently, he is visiting researcher at Harvard University. Also, he is a teacher in the Department of Software Engineering and Artificial Intelligence at the Complutense University in Madrid, Spain. His research interests focus on educational games and their use in theater, cinema, and dance.

Clara Fernández-Vara received the PhD degree in digital media from the Georgia Institute of Technology in 2009. She is currently an associate professor at the Game Center, New York University. Her research interest is focused on the application of close-reading methods and performance studies to the study of videogames. Her work concentrates on adventure games, as well as strategies to integrate narrative in digital environment through interaction and spatial design.

Javier Torrente received the MSc and PhD degrees in computer science from UCM. His PhD degree focused on how to reduce the cost of making digital games so that they are more accessible for people with a disability. Currently, he works as a full-time researcher for University College London, UK, and he was formerly a member of the e-UCM research group at UCM, Madrid, Spain. He has published more than 70 research papers in academic journals and conferences in the fields of serious games, HCI, and accessibility.

Baltasar Fernández-Manjón received the PhD degree in physics from the Universidad Complutense de Madrid in 1996. He is a full professor of computer science at UCM and director of the e-UCM e-learning research group. His research interest is focused on the applications of ICT in education and in serious games and educational simulations applied to different domains (e.g., medicine, culture, and languages). He is also working in the application of e-learning standards to the integration of those technologies in e-learning systems. He is a senior member of the IEEE.