



Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Can educational video games increase high school students' interest in theatre?



Borja Manero ^{a,*}, Javier Torrente ^b, Ángel Serrano ^a, Iván Martínez-Ortiz ^a, Baltasar Fernández-Manjón ^a

^a Department of Software Engineering and Artificial Intelligence, Complutense University of Madrid, Madrid, Spain

^b Department of Computer Science, University College London, London, United Kingdom

ARTICLE INFO

Article history:

Received 29 January 2015

Received in revised form 18 June 2015

Accepted 22 June 2015

Available online 30 June 2015

Keywords:

Serious games

Theatre learning

Media in education

Educational games

Digital humanities

ABSTRACT

The value of educational video games in education is undeniable and the benefits of using video games in classroom instruction have been proved by many researchers. Nevertheless, these benefits have not been proved sufficiently for some domains, such as artistic disciplines. In this paper we explore the effects of an educational video game on high school students' interest towards classical theatre. The game covers the story of "The Foolish Lady" (*La Dama Boba*) based on the homonymous classic theatre play by Spanish playwright Lope de Vega. A mixed experimental design was followed, whereby researchers conducted pre-tests and post-tests to estimate the effect of playing the video game on student interest (within-subjects factor) towards theatre. We also measured changes in linguistic knowledge and knowledge about the play. The experiment was carried out with 754 students from 8 different schools in the Madrid region in Spain, divided into experimental group and two control groups. With the objective of improving the comparative power of the study, two control groups were used: (1) traditional teaching with the usual teacher and, (2) as the best educative case we could implement, teaching with a professional actor who had played the male protagonist of the theatre play. The experimental group played the video game. Results show that the video game was more effective in incrementing students' interest in theatre than the traditional class, but slightly less effective than the class with the actor. On the other hand, game and teacher approaches obtained similar results in the improvement of students' knowledge about the play's plot and some linguistic concepts. These results open up a new horizon in using video games as motivators in different artistic domains.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

Theatre is less and less interesting to young people. According to a study at Palermo University (Argentina), 81% of young men and woman (aged from 10 to 24 years old) declare that they never attend the theatre (Palermo, 2009). In Chile, 81.4% of the population states that they did not attend the theatre during the previous year (Consorcio de las Artes, 2011). In the US,

* Corresponding author. Department of Software Engineering and Artificial Intelligence, Complutense University of Madrid, Facultad de Informática, Calle Profesor Jose Garcia Santesmases, s/n., 28040 Madrid, Spain.

E-mail address: bmanero@ucm.es (B. Manero).

the national conference of the Theatre Communications Group, whose membership includes more than 500 theatres across the country, agreed that the lack of young people in theatres has been a persistent problem for years, and the American theatre needs to find a concrete solution quickly (Aucoin, 2012).

In Spain, the gap between the theatre and young people (aged less than 20) is one of the problems that jeopardize the future of this literary genre in the medium term. If we fail to attract new generations to the theatre, and that lack of interest sets a trend, theatre might become a recreation for elites (Sociedad General de autores y editores, 2012). For classic theatre it is even worse, as the few young people attending classical plays are, normally, forced to attend by their school (Quero, 2002).

One of the key factors that may explain the low consumption of scenic arts in Spain is the lack of appropriate policies addressed to catch young people's interest. 75.4% of the population declares that they almost never go to the theatre, whereas only 3.0% consider it a good leisure alternative that they frequently attend. People who attended the theatre at an early age present a higher current consumption rate (69.1% of the theatregoers) (Quero, 2002). Therefore, the high interest in theatre detected among regular theatregoers leads us to think that it is possible to increase theatre attendance by engaging new generations with theatre. In order to reverse the actual downward tendency, the theatre sector needs to increase its influence in other sectors— especially in education. A priority for the theatre sector in Spain is to increase the attractiveness of the theatre through educational programs, motivating young people towards attending the theatre.

Young people's lack of interest in classical theatre contrasts with their notorious intrinsic motivation towards video games (Gee, 2003). Video games have become widely adopted by new generations of users, the so-called digital natives, who have grown up immersed in new communication technologies (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012). For example, a study on 7–16 year-old students in the UK showed that most of them were regular domestic game players (McFarlane, Sparrowhawk, & Heald, 2002).

Many researchers have indicated the potential of employing educational computer games to help students improve their learning performance (Brom, Preuss, & Klement, 2011; Hwang, Wu, & Chen, 2012). Different studies have indicated that educational computer games could be an effective way of providing a more interesting learning environment for acquiring knowledge (Moreno-Ger, Burgos, Martínez-Ortiz, Sierra, & Fernández-Manjón, 2008; Papastergiou, 2009; Sung & Hwang, 2013). Some researchers have also reported that educational computer games can enhance the learning interest of students (Ebner & Holzinger, 2007; Malone, 1981), and further increase their learning motivation (Dickey, 2011; Hwang et al., 2012; Van Eck, 2007). Some argued that a well-designed educational computer game could provide a rich-resource learning environment with challenging learning missions to foster students' skills and higher order knowledge. Wang and Chen, (2010) have further pointed out that: "... via properly integrating learning content and strategies into the game-based learning environment, students' learning performance could be improved while maintaining the enjoyable nature of the games".

In the past decade, many studies have also been conducted to investigate the effectiveness of educational video games especially in STEM (Science, Technology, Engineering and Mathematics) disciplines, such as mathematics (Bos & Shami, 2006; Lowrie & Jorgensen, 2011), computer science (Papastergiou, 2009), visuospatial reasoning (Gueven & Kosa, 2008), civil engineering (Ebner & Holzinger, 2007) or business (Guillén-Nieto & Aleson-Carbonell, 2012). Comparatively, the potential benefits of applying educational video games in humanities have been less explored. There have been some experiences in social science (Cuenca López & Martín Cáceres, 2010), geography (Tuzun, Yilmazsoylu, Karakus, Inal, & Kizilkaya, 2009), language (Ravenscroft, 2007) or history, but other humanities disciplines have not received the same level of attention (Chou & Tsai, 2007). This is the case in literature and classical theatre.

Summarizing, the effectiveness and benefits of educational video games has already been proven in many different fields. However, surprisingly, video games have not been widely used in arts, and they have not been used before to teach (or in this case to motivate) an artistic subject such as theatre. Their effectiveness in the fields of arts remains to be proven. This study intends to clarify whether educational video games could also promote the interest towards theatre by analysing the impact of an educational video game on teenagers.

This discussion can help us to learn whether educational video games may be effective (within real school settings) in promoting the acquisition of domain knowledge in the arts and in engaging students in the learning process.

2. Purpose of the study and research questions

In this study, the main goal was to test the effectiveness of an educational video game as a motivating device to increase young people's interest in going to the theatre. To explore this issue, we created *La Dama Boba* ("The Foolish Lady" in English), a video game based on the homonymous classical play by Spanish playwright Lope de Vega (1613). A tool designed to motivate high school students to attend classical theatre plays and to learn more about the story, language and versification of that specific play (Manero, Fernández-Vara, & Fernández-Manjón, 2013a). Thus, the main research question is:

RQ1.1. Can the game *La Dama Boba* improve students' interest (I, from now on) in classical theatre?

A second goal for the study was to explore the educational properties of the game (learning performance). First, we believe the game can reveal the plot and the characters of the classical play *La Dama Boba* more clearly to students. From now on, we will refer to this subject as *plot knowledge*, hereafter abbreviated to PK. Second, the game can be useful to learn new linguistic concepts, which are frequently used in the theatre like the literary figure of the metaphor or the *redondilla* (a type of Spanish

poetic composition that uses a specific rhyming scheme and verse length), which is used in *La Dama Boba* to talk about love. We will refer to this knowledge as *linguistic knowledge*, or LK. Therefore, we also propose this additional research question:

RQ1.2. Can the game *La Dama Boba* improve students' knowledge of linguistic concepts (LK hereinafter) and their knowledge about *La Dama Boba's* plot (PK from now on)?

2.1. Comparing the motivational and educational effects with different learning approaches

The most common instructional approach to theatre in Western countries is the teacher, usually through lectures. Regular instruction is the usual channel where students hear and learn about theatre. Besides, in educational video games experiments, the effects of the games are usually compared to regular instruction, following a typical experimental group versus control group approach. Therefore, we follow this very same setup for the experiment where the main control group we chose to compare with the game was a lecture by the students' usual teacher.

Nevertheless, using only one control group usually limits the discussion on the size effect, since the game's effects can only be compared to a bottom-line control measurement. Besides, this approach raises concerns as to whether it was the game that caused the growth in motivation or whether it was just a by-product of introducing a novelty in the classroom. For those reasons, we set out to compare game-based instruction not only to regular instruction but also to another approach it could be outperformed by. This gave us a top-line to compare with and also a means to remove the bias introduced by novelty. Some Spanish theatre companies assured us that, in their experience, the best way to enhance young people's interest towards a specific theatre play was to send one of their actors to the school to explain in advance the theatre play to the students. Therefore, as a second experimental approach we recruited a professional actor who had previously played the male protagonist in an adaptation of the play *La Dama Boba* and who had previous experience in teaching theatre, to give students a talk on the play. With this new educational approach, we defined the following research questions for this study:

RQ2.1.a Is the game *La Dama Boba* more effective at improving students' interest in classical theatre (I) than the traditional approach (teacher)?

RQ2.1.b Is it more effective at improving I than the actor approach?

RQ2.2.a Is the game *La Dama Boba* more effective at improving students' knowledge of linguistic concepts (LK) and their knowledge about *La Dama Boba's* plot (PK) than the traditional approach?

RQ2.2.b Is it more effective at improving LK and PK than the actor approach?

3. Methodology

3.1. Participants

The study involved $N = 754$ high school students from 8 different schools in Madrid. All the students from one of the schools (public school) were removed from the study (48 students) due to a power cut occurred during the experience. 9 more students were also removed because they experienced different problems while playing the game (power cuts or malfunctioning of the computers).

The gender proportion in the resulting population ($N = 697$) was 55.1% males, and 44.9% females. The median age was 14. By schools, 3 were private or charter schools (52.7% of the participants), and 4 public schools (47.3% of the participants). In terms of gender, age and school distribution, this sample is representative of the student population in the Madrid region for this age (Comunidad de Madrid, 2011; Ministerio de Educacion, 2008). 94.6% of the students did not know the plot of the play *La Dama Boba* before the study, since we advised the teachers not to mention anything related to its plot prior to the experiment. Students showed poor theatre attendance rates, which suggests low interest in the subject: 61.9% never attended the theatre during the previous year and 23.6% only once.

Table 1 shows the distribution of the participants according to gender, intervention group and type of school.

Table 1
Demographics of participants.

Demographics		Game based instruction (EG)	Regular instruction (TG)	Actor-driven instruction (AG)	Total
Gender	Male	177 (52.2%)	122 (58.9%)	85 (56.3%)	55.1%
	Female	162 (47.8%)	85 (41.1%)	66 (43.7%)	44.9%
Public or Private school	Private	181 (53.4%)	103 (49.8%)	83 (55%)	47.3%
	Public	158 (46.6%)	104 (50.2%)	68 (45%)	52.7%
Age (Mean)		13.86 ± 1.47	13.99 ± .95	13.62 ± 2.00	13.85 ± 1.48
Total		339	207	151	697

3.2. Experimental design

The classes were divided in two: half of the students played the game and the other half listened to a lecture (either by the actor or by the instructor). We used a randomization algorithm to ensure 1) that the demographics of the two groups were as homogeneous as possible, and 2) that students of the same school were evenly distributed in game group (Experimental Group, EG) and control groups (Actor Group, AG; or Teacher Group, TG). Logistic restrictions (e.g. size of different rooms) provided by each school made it impossible to allocate exactly the same number of students to each of the groups (N = 339 for EG; N = 207 for TG and N = 151 for AG, with a total N = 358 in control groups).

The experiment was designed to fit into the standard duration of a secondary school class (50 min). All the students started filling the same pre-test questionnaire (we will analyse the questionnaires in next section), containing demographic questions and instruments to measure: 1) interest towards theatre (I), 2) linguistic knowledge (LK) and 3) knowledge about the play (PK). This took less than 5 min. The post-test questionnaire includes these same three instruments (to determine the knowledge gain), plus satisfaction questions. Data from pre and post-tests were anonymous to ensure the privacy of the students. Both tests were paired through a numeric code that each student received at the beginning of the experience. The detailed descriptions of the questionnaires are included in section 3.3.2.

After that, students attended the type of instruction they were assigned for a 40 min session. Students belonging to the actor and teacher's groups (control groups) stayed in their usual classroom, while game group (experimental group) students went to the computer lab.

Students in the control groups (TG or AG) received a class about *La Dama Boba* either by the actor or by their usual teacher. All the didactic material used in both control groups was provided by researchers to minimize differences produced by content and to ensure that the same concepts were covered by all three instructional approaches. It consisted of a PowerPoint™ slides presentation as back-up material to support their instruction.

Students in the EG (game group) played the game *La Dama Boba* under the supervision of a researcher who did not provide any sort of assistance but observed students' interaction with the application. They were allowed to play as many times as desired during the class. After the instruction, 5 min before the end of the session, all the students completed a post-test questionnaire with the same three instruments included in the pre-test (to determine gain).

The post-test questionnaire also collected data to measure the students' satisfaction with the experience (from now on, Experience Evaluation, EE), as a way to determine which approach they liked the most. From now on, we will refer to this type of data collected as "experience evaluation". The next figure (Fig. 1) summarizes the research design of the experiment.

3.3. Materials and instruments

3.3.1. *La Dama Boba* video game

The video game *La Dama Boba* (Fig. 2), which is described in full detail in (Manero, Fernández-Vara, & Fernández-Manjón, 2013b), is based on a classic Spanish play,¹ where the player incarnates the protagonist of the theatre play. The player has to go through the plot of the play making some decisions that could lead him to a different story. Before addressing the specifics of the game, the principal designer of the game (one of the researchers) attended rehearsals of the play for two months. Afterwards the designer wrote a first draft of the game script. The adapted script was developed after identifying the most important events of the play according to the protagonist's point of view, and by using acting methods to create the characters. The script was iteratively revised, simplified and adapted to comply with the format and estimated duration (40 min) required for classroom use of the computer game.

The game was designed to be a graphic adventure for several reasons: because of the strong underlying narrative underpinnings of this genre (Padilla-Zea, Gutiérrez, López-Arcos, Abad-Arranz, & Paderewski, 2013), because it aligns well with learning scenarios where problem-solving and critical and deductive reasoning are important (Dickey, 2006), and lastly because of its ability to engage students through an appealing story by creating empathy with characters (Garris, Ahlers, & Driskell, 2002). The game also includes puzzles and mini-games to increase its playability. Adventure games combine stories and puzzles in a segmented form. Understanding puzzles as a type of challenge where the opponent is not another player, but a specific problem that needs a solution or explanation.

We conducted a formative evaluation session with graduate students (Manero et al., 2013a) and most of the teachers involved in the experiment. Their feedback helped us to find and fix implementation flaws, to improve the educational game design and to get it better aligned with the goal we were pursuing. Among the most significant changes that we made to the game thanks to this evaluation were:

- Increasing the game's narrative and playability possibilities so that it was not an exclusive narrated story, but one in which the player had a chance to choose her own story by choosing different paths.
- Integrating all of the tests, the player have to complete during the game, in her character's history. This way the player has the sensation of playing a game instead of thinking that she is doing an exam disguised as a video game (stealth assessment) (Shute, 2011).

¹ Download the game: <http://en.damaboba.e-ucm.es/downloads>.

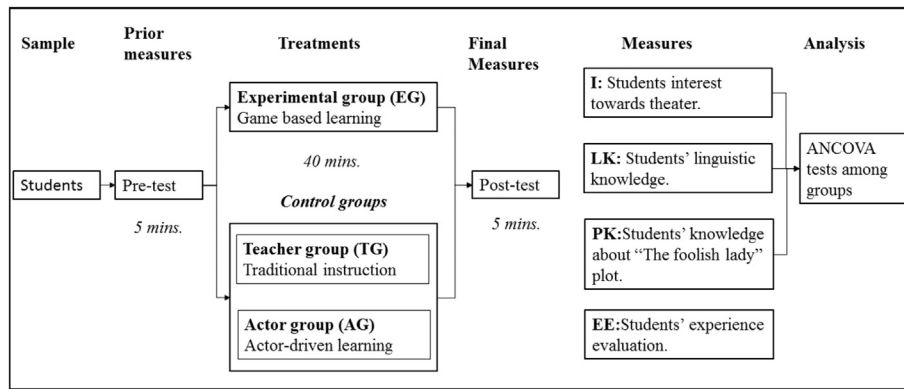


Fig. 1. Research design of “The Foolish Lady” experiment.

- Finally, mini-games or tests integrated in the game were modified thanks to the supervision of those responsible for the subject of language so that the level was adapted to students' needs.

3.3.2. Questionnaires

For the purposes of the investigation, two paper-based questionnaires were constructed by the researchers: 1) a pretest questionnaire consisting of four parts (biographical variables, interest on classic theatre, linguistic knowledge and play knowledge) and 2) a posttest questionnaire consisting of four parts (interest on classic theatre, linguistic knowledge, play knowledge and experience evaluation).

The first part of the pre-test questionnaire elicited the following biographical data: students' gender, age, public or private school, and their theatre habits. The second part of the pre-test questionnaire was aimed at assessing students' interest in classical theatre (I), linguistic knowledge (LK) and *La Dama Boba* play knowledge (PK). This instrument was constructed by the researchers and examined as to its content validity by a panel of 10 experienced high school teachers. All the informational content that a student would need to study in order to be able to answer those questions was contained in the learning material of the actor, the teacher and the game. The post-test questionnaire was targeted at measuring I, LK and PK after the completion of the interventions, and consisted of the same questions included in the pre-test. Finally, it included a question assessing the evaluation of the experience, and a free text section where they could write their impressions about the learning instruction.

In total, we used 4 instruments (comprising 12 items) to measure 4 dependent variables. Table 2 describes each instrument and the resulting dependent variable.

Interest in theatre (I) variable, students' answers ranged from 1 to 7. Therefore, possible scores in this test ranged from 3 to 21 points. In the LK and PK variables (pre-test and post-test), the students' number of correct answers was considered as their score in the respective test. Possible scores in each test, thus, ranged from 0 to 4 points. Finally, experience evaluation (EE) was measured by one single question from 1 to 7.

Internal consistency of the scale used for student interest in theatre play (I) was measured through Cronbach's Alpha test, resulting in .785 for I in the pre-test, .850 in the post-test. Cronbach's Alpha test could not be used in the other instruments because of their nature.



Fig. 2. Final stage in the game (left). Snapshot of a puzzle in the game (right).

Table 2
Summary of instruments.

Instrument	Type	Variable measured	How it is calculated	Number of items	Range
Student interest scale	7-point Likert scale	I: Student interest on theatre play	Summing up values of all items	3	[3–21]
Linguistic knowledge test	Multiple-choice questions with one valid answer	LK: Linguistic knowledge	Each item contributes 1 to the total if the answer is correct, 0 if incorrect.	4	[0–4]
Theatre play knowledge test	Multiple-choice questions with one valid answer	PK: Plot knowledge	Each item contributes 1 to the total if the answer is correct, 0 if incorrect.	4	[0–4]
Experience evaluation	7-point Likert scale	EE: Experience evaluation		1	[1–7]

4. Results

4.1. Improving students' interest (I), knowledge of linguistic concepts (LK) and the play *La Dama Boba's plot* (PK)

To test the learning effectiveness of *La Dama Boba* game, we obtained, in the game group, the mean of the results making up the pre-knowledge and post-knowledge tests for each of the three variables (I, LK and PK) (see Table 3). Then, to answer research questions RQ1.1 and RQ1.2 (see section 2), we needed to determine whether those observed differences were statistically significant or not. To that end, we conducted paired samples t-tests on the three dependent variables (a) I: Interest towards theatre, (b) LK: linguistic knowledge, and (c) PK: knowledge about the plot.

The t-test showed statistically significant differences in the results obtained for each of the three variables (see Table 3). To be exact, the differences observed among all the dependent variables resulted highly significant ($p < .001$). Both, interest towards theatre (I; $t = 11.16$) and linguistic knowledge (LK; $t = 10.43$) showed a similar increment, while the difference perceived in plot knowledge (PK; $t = 37.55$) was much higher. This makes perfect sense taking into account that the students' prior knowledge about the play was almost non-existent.

4.2. Comparing educational approaches outcomes

To answer research questions RQ2.1 and RQ2.2 (proposed in section 2) we conducted a comparison analysis among the three groups. First, we ran a one-way ANOVA analysis for I, PK and LK pre-test scores to compare the starting points of each group. The results showed (see Table 4) that there were statistically significant differences in the pre-test's scores for I, LK and PK (I: $F = 4.59$, $p < .05$; LK: $F = 14.61$, $p < .05$; $F = 3.36$, $p < .05$) among the three groups. We ascribe the difference of interest (I) to the novelty introduced by both the game and actor instructional approaches, a novelty which is not present for the teacher group, where students attended regular instruction. Differences in PK and LK might be caused by the slightly uneven age distribution across groups.

These differences among pre-test scores led us to use an analysis of covariance (ANCOVA) to assess the effectiveness of the interventions excluding the differences on students' pre-test scores. Dependent variables were the post-test scores for I, LK and PK. The independent variable was the group to which the students belonged, having three different levels (game, teacher, and actor). Finally, students' scores on the pre-test served as a covariate in this analysis, to control pre-existing differences among the groups.

Before conducting the ANCOVA on students' post-test scores to evaluate the effectiveness of the three interventions, preliminary checks were performed to confirm that there was no violation of the assumptions of normality, linearity, homogeneity of variances and homogeneity of regression slopes (Pallant, 2010).

After adjusting I post-test scores for scores in the pre-test (covariate) by ANCOVA analysis (see Table 5), a statistically significant main effect was found for the type of intervention on the I post-test scores ($F = 10.38$, $p < .05$). As shown in Table 6, Bonferroni post hoc analysis (pairwise comparisons) showed that the actor's approach (AG; adj. mean: 13.65) outperformed the other two approaches for I. On the other hand, game's group (EG; adj. mean: 12.96) was a statistically significant (mean

Table 3
Output of the paired samples t-tests run on each dependent variable for the game group.

Dep. variable	Comparison pre-post tests			t-test					95% Confidence interval	
	N	Pre-test scores mean	Post-test scores mean	t	Df	Sig (2-tailed)	Mean difference	Std. Error difference	Lower	Upper
Interest (I)	339	11.62 ± 4.00	13.12 ± 4.32	11.16	338	.000	1.50	2.48	1.24	1.78
Linguistic knowledge (LK)	339	2.45 ± 1.07	3.06 ± .99	10.43	338	.000	.62	1.1	.50	.73
Play knowledge (PK)	339	.35 ± .78	3.00 ± 1.10	37.55	338	.000	2.66	1.30	2.52	2.79

Table 4

Pre-tests scores for I, LK and PK by intervention group.

Dep.variable	Actor		Game		Teacher		F
	Mean	SD	Mean	SD	Mean	SD	
Interest (I)	11.97	4.27	11.62	4.00	10.74	4.14	4.59*
Linguistic knowledge (LK)	2.03	1.14	2.45	1.07	2.63	.92	14.61*
Play knowledge (PK)	.27	.74	.35	.78	.44	.84	3.36*

* $p < .05$.**Table 5**

ANCOVA of the post-test results for I, LK and PK by intervention group.

Dep.variable	Actor		Game		Teacher		F
	Adj.Mean	S.Err.	Adj.Mean	S.Err.	Adj.Mean	S.Err.	
Interest (I)	13.65	.21	12.96	.14	12.40	.18	10.38*
Linguistic knowledge (LK)	3.33	.07	3.05	.04	3.04	.06	7.01*
Play knowledge (PK)	3.82	.08	3.00	.05	2.90	.07	46.73*

* $p < .05$.

difference = .56; $p < .05$) better approach for increasing the interest (I) than teacher's (TG; adj. mean = 12.40). Table 5 also includes the Cohen's d as an estimate of the effect size (using post-pre means) to compare the improvements occurred among different educational approaches.

ANCOVA test for LK also showed significant differences among groups ($F = 7.01$, $p < .05$). The post-hoc analysis showed that the actor achieved the highest adjusted mean (3.33), this difference being statistically significant ($p < .05$) compared to the game group (3.05) and the teacher group (3.04). In this case, the difference between game and teacher was not statistically significant ($p > .05$).

Finally, ANCOVA test yielded similar results for the increase in play knowledge (PK). Differences across groups were statistically significant ($F = 46.73$, $p < .05$), the actor group being significantly higher (3.82) after the post-hoc test ($p < .05$) than the game group (3.00) and the teacher group (2.90). No differences between game and teacher groups were found ($p > .05$).

4.3. Experience evaluation

As we mentioned above, the post-test included a question to evaluate the experience (EE). Statistical analysis of these results showed significant differences among groups ($F = 43.24$, $p < .05$) in the students' evaluation of the experience. Post-hoc analysis showed that the difference between the game group and the teacher group was also significant. Therefore, the game ended up being a more valued approach than teacher approach did, and, as expected, the actor was the students' preferred approach. The students of the game and actor groups were certainly more enthusiastic about the possibility of repeating the experience with other theatre plays than those of the teacher group.

4.4. Observation of students' interaction with the game

According to the informal data gathered from the researcher's observations, all the students without exception seemed enthusiastic when they were told that they would use a game for educational purposes. During their interaction with the game, they seemed very absorbed and interested in the task, and exhibited high levels of engagement to achieve the best end,

Table 6

Pairwise comparisons by dependent variable.

Dep.variable	Main group (I)	Secondary group (J)	Mean difference (I-J)	Std. Error	Cohen's d	Effect-size r
Interest (I)	Game	Teacher	.56*	.22	.18	.09
	Game	Actor	-.68*	.25	-.24	-.12
	Actor	Teacher	1.25*	.27	.40	.20
Linguistic knowledge (LK)	Game	Teacher	.01	.07	.1	.05
	Game	Actor	-.29*	.08	-.48	-.23
	Actor	Teacher	.30*	.09	.67	.32
Play knowledge (PK)	Game	Teacher	.10	.09	.15	.08
	Game	Actor	-.82*	.09	-.80	-.37
	Actor	Teacher	.92*	.10	.97	.44

Based on estimated marginal means. Adjustment for multiple comparisons: Bonferroni.

*The mean difference is significant at the .05 level.

especially those students that used the headphones (some schools did not have sound cards installed in their computers) and were able to listen to the game's sounds.

There was relative quiet during the intervention, broken by exclamations of satisfaction from students who had managed to win a mini game, by questions from students who had problems coming across any obstacles and by short dialogues regarding the exchange of procedural information and tips about the game. Those exclamations and dialogues were initiated mainly by boys, whereas girls seemed to play more on their own. Researchers observed that boys tend to play faster, clicking everywhere, reading the dialogues less, and, in general terms, obtaining worse results than girls. On the other hand, girls tend to play more slowly, reading the dialogues carefully, and scoring higher than boys.

5. Discussion

Throughout this section, we will try to answer the research questions set out in section 2 by discussing the evidence reported in the results section.

RQ1.1. and RQ1.2. Can the game *La Dama Boba* improve students' interest towards classical theatre (I), students' knowledge of linguistic concepts (LK) and of the play's plot (PK)?

Yes. Results of the paired samples t-tests conducted showed that the game was effective in improving these three aspects. The increment in both interest and knowledge revealed the effectiveness of the game, and even more regarding the short time intervention. Specially, the results in linguistic concepts (LK) were unexpected since the improvement in those kind of concepts often need longer time expositions. The large increase in the students' knowledge about *La Dama Boba* plot (PK) (66.25% as a percentage) suggests the effectiveness of the game as a theatre plots teacher. Moreover, after playing the game, researchers noted that the students seemed enthusiastic about what happened in the real play, and with the idea of going to see it in the theatre.

The results we obtained corroborate the pedagogical advantages of educational video games that many authors have argued in the literature (Brom et al., 2011; Dickey, 2011; Hwang & Chang, 2011; Papastergiou, 2009).

RQ2.1.a) Is the game *La Dama Boba* more effective at increasing students' interest in classic theatre than the traditional instructional approach (teacher)?

Yes. Data showed statistically difference ($p < .05$) between game based instruction and regular instruction (teacher-based). Students in EG achieved higher scores in the pre-test (the difference was statistically significant), probably due, at least partly, to novelty. Even so, after intervention, students in EG scored .56 higher than students in TG on average in the post-test (adjusted mean, see Table 4), this difference being statistically significant. Therefore, we could argue that the game was a better approach than teacher's in increasing interest towards classic theatre. The Cohen's d results (see Table 5) for the game/teacher yielded a value of .18 for I (small effect), which means that the mean of the game's group, during our short educational intervention, is approximately at the 58% percentile of the teacher's group.

RQ2.1.b) Is the game *La Dama Boba* more effective at increasing students' interest in classic theatre than the actor approach?

No. Actor-based instruction was the most effective instruction. This was the expected result by researchers since actor's approach was included as a top-line approach. Cohen's d between game and actor approaches gave as a value of .25 (small effect) for I, what led us to think that game was approximately in the midway between teacher and actor approaches as interest increaser towards theatre.

RQ2.2.a) Is the game *La Dama Boba* more effective at improving students' PK and LK than the traditional approach?

No. The game showed the same performance as the teacher in improving students' knowledge about the play (PK) and their linguistic knowledge (LK). There was no statistical difference between game-based and regular instruction, although the adjusted means achieved for EG were greater than for TG (3.00 Vs 2.90 for PK, 3.05 Vs 3.04 for LK). Notice that, in particular for linguistic knowledge (LK), relevant improvements were difficult to achieve with such a short time intervention. Cohen's d for both dependent variables (in game/teacher comparison) showed small positive effects in favour of game (see Table 5)

RQ2.2.b) Is the game *La Dama Boba* more effective at improving students' PK and LK than the actor approach?

No. Actor-driven instruction was again the statistically most effective approach at improving students' knowledge about the play (PK) and linguistic knowledge (LK). In this case, Cohen's d showed that actor's approach produces large effects for both PK and LK in comparison with the other two approaches.

The analysis of the second part of the feedback questionnaire revealed that students in both groups had positive attitudes towards the adoption of the learning modes they had not experienced in school. Students in the actor and in the game groups found their respective learning modes more fun, engaging, and active than those in the teacher group. As stated by a boy from the game group in the free comments text box of the post-test: 'It has been very fun and I have learnt a lot about the play without having read it. Now, I really look forward to attending the real play'. There have been many more comments from

students in the actor and game groups than from the teacher group. The proposals made by those who played the game referred mainly to improvements in the graphics, as well as to the addition of more mini games.

These facts lead us to think that educational video games could motivate young people to attend theatre plays and reverse the downward trend observed both in Spain (SGAE, 2014) and abroad (Artes, 2011; Aucoin, 2012; Universidad de Palermo & TNS Gallup, 2009). These findings also suggest that the positive effects that educational video games have shown in STEM disciplines (Bos & Shami, 2006; Mayo, 2009; Papastergiou, 2009) can be transferred to the performing arts.

6. Conclusions and limitations

This study provided empirical evidence that educational video games can be used as motivational tools within high school theatre courses, since they can increase the interest of the students towards theatre. Our findings support the outcomes of previous studies (Munz, Schumm, Wiesebrock, & Allgower, 2007; Tuzun et al., 2009), which argued that educational video games increased the motivation of the participants in different topics such as geography or engineering. However, this study suggests that educational video games can be also effective in an unexplored domain such as the arts, specifically in theatre.

As controls for the video game condition, we used two lectures, the first given by a professional actor (as a top-line approach) and the second by students' usual teacher. As expected, the actor-driven approach proved to be the most effective. Nevertheless, this approach is not practically implementable as it is much more complex and expensive to deploy in schools than the game: for most of the schools we attended, the actor-driven approach would be unaffordable. Notice that it was not just an actor teaching theatre, it was the protagonist of the real play talking about the play he was currently playing. On the other hand, from the motivational perspective, game-based instruction achieved better results than regular instruction, making the game a valuable and cost-effective educational tool. Currently, many of the schools involved in the experiment are reusing the game in subsequent academic years, with no additional cost or effort. Moreover, according to some teachers involved in the experience, the game could be an excellent starting point to promote further discussion and to achieve a deeper and more enjoyable knowledge of the theatre play.

Besides, as a secondary objective, the study investigated the effect of this game as a learning tool, exploring the improvement of students' knowledge about the play's plot, and some linguistic concepts. Even though we did not find statistically significant differences between the game and the teacher, the game proved its effectiveness in both fields (increasing the knowledge), especially for teaching the play's plot. Taking into account that students scored much higher in the game condition than the teacher's in the final evaluation, we argue that the game could represent a more enjoyable and engaging approach, with better results as a motivator, and similar learning outcomes. Moreover, this study supports video games as a cost-effective learning tool that educational administration can provide and distribute as a self-contained learning strategy to cover different curricula topics.

This study had certain limitations. The instruments used were limited. We found no fully validated instruments for this particular purpose and target population so we had to develop our own. These instruments are composed of a small number of items (3–4), because of the limited time available for the experiment, thus producing measurements on a small scale. Students were exposed to instruction for a short time, which also hinders the observation of effects (especially in language learning). In the future, it would be interesting to continue the research, using more complex instruments and with longer exposure times for instruction. However, such an investigation was impossible to conduct due to restrictions in the high schools' timetables. It also would be interesting to monitor how often students go to the theatre to determine the actual impact on their motivation, or even to complete the activity by attending the theatre (to watch the same play adapted in the game) with the students to measure which approach had more influence in their engaging with the play. *La Dama Boba* game was relatively simple, designed to comply with the format and estimated duration (40 min) of a standard high school class. As observed in different studies (Facer, Furlong, Furlong, & Sutherland, 2003; Papastergiou, 2009), we think that with better graphics and animations and a more complex storyline for the game would yield better results, as it would be more similar to the games students are used to playing. We would like to emphasize that educational video games should not overlook the core features that make commercial video games attractive for students.

This study should have repercussions for educational games designers and for art curriculum developers. The former should open up the range of possibilities in creating games for different artistic domains such as theatre, opera, music, painting or dance. The latter should bear in mind the potential of the educational video games to include them on the artistic agendas of the schools. We consider this study just the first step in applying video games in the theatre domain. We are currently working in a new collaboration with the National Classical Theatre Company (one of the main theatre policy-makers in Spain) and compare the present results with a new game about a different classical theatre play (*The courtesy of Spain*).

Acknowledgements

The e-UCM research group has been partially funded by Regional Government of Madrid (eMadrid S2013/ICE-2715), by the Complutense University of Madrid (GR3/14-921340), by the Ministry of Education (TIN2013-46149-C2-1-R), by the RIURE Network (CYTED 513RT0471) and by the European Commission (RAGE H2020-ICT-2014-1-644187).

We would also like to thank to *Réplica Teatro* to allow us attending to their rehearsals and to give us permission to base our game on their play adaptation. We thank to all the schools involved in this experiment, particularly to Carlos García. We also

thank Ricardo García Mata for his help in the statistical analysis. Finally, thanks to Agatha Ruiz de la Prada for allowing us to use her designs.

References

- Artes, C. de las (2011). *Reporte estadístico de teatro*. Retrieved from <http://www.cultura.gob.cl/reporteteatro/reporteteatro.pdf>.
- Aucoin, D. (2012). *Phantom of the theater: Audience is getting older*. Boston. Retrieved from http://www.boston.com/ae/theater_arts/articles/2012/06/17/theater_audiences_are_getting_older/.
- Bos, N., & Shami, N. S. (2006). Adapting a face-to-face role-playing simulation for online play. *Educational Technology Research and Development*, 54(5), 493–521.
- Brom, C., Preuss, M., & Klement, D. (2011). Are educational computer micro-games engaging and effective for knowledge acquisition at high-schools? A quasi-experimental study. *Computers & Education*, 57(3), 1971–1988.
- Chou, C., & Tsai, M.-J. (2007). Gender differences in Taiwan high school students' computer game playing. *Computers in Human Behavior*, 23(1), 812–824. <http://dx.doi.org/10.1016/j.chb.2004.11.011>.
- Comunidad de madrid. (2011). *Datos y Cifras de la Educación*. Retrieved from http://www.madrid.org/cs/Satellite?blobcol=urldata&blobheader=application/pdf&blobheadervalue1=Content-Disposition&blobheadervalue1=filename=DATOS+Y+CIFRAS+2010_2011.pdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1271936872331&ssbinary=true.
- Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education*, 59(2), 661–686. <http://dx.doi.org/10.1016/j.compedu.2012.03.004>.
- Cuenca López, J. M., & Martín Cáceres, M. J. (2010). Virtual games in social science education. *Computers & Education*, 55(3), 1336–1345.
- Dickey, M. D. (2006). Game design narrative for learning: appropriating adventure game design narrative devices and techniques for the design of interactive learning environments. *Educational Technology Research and Development*, 54(3), 245–263.
- Dickey, M. D. (2011). Murder on Grimm Isle: the impact of game narrative design in an educational game-based learning environment. *British Journal of Educational Technology*, 42(3), 456–469. <http://dx.doi.org/10.1111/j.1467-8535.2009.01032.x>.
- Ebner, M., & Holzinger, A. (2007). Successful implementation of user-centered game based learning in higher education: an example from civil engineering. *Computers & Education*, 49(3), 873–890.
- Facer, K., Furlong, J., Furlong, R., & Sutherland, R. (2003). *Screenplay: Children and computing in the home*. Taylor & Francis.
- Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: a research and practice model. *Simulation & Gaming*, 33(4), 441–467. <http://dx.doi.org/10.1177/1046878102238607>.
- Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment*, 1(1), 20. <http://dx.doi.org/10.1145/950566.950595>.
- Gueven, B., & Kosa, T. (2008). The effect of dynamic geometry software on student mathematics teachers' spatial visualization skills. *Development*, 2, 3D.
- Guillén-Nieto, V., & Aleson-Carbonell, M. (2012). Serious games and learning effectiveness: the case of It's a Deal! *Computers & Education*, 58(1), 435–448. <http://dx.doi.org/10.1016/j.compedu.2011.07.015>.
- Hwang, G.-J., & Chang, H.-F. (2011). A formative assessment-based mobile learning approach to improving the learning attitudes and achievements of students. *Computers & Education*, 56(4), 1023–1031. <http://dx.doi.org/10.1016/j.compedu.2010.12.002>.
- Hwang, G.-J., Wu, P.-H., & Chen, C.-C. (2012). An online game approach for improving students' learning performance in web-based problem-solving activities. *Computers & Education*, 59(4), 1246–1256. <http://dx.doi.org/10.1016/j.compedu.2012.05.009>.
- Lowrie, T., & Jorgensen, R. (2011). Gender differences in students' mathematics game playing. *Computers & Education*, 57(4), 2244–2248.
- Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science*, 5(4), 333–369.
- Manero, B., Fernández-Vara, C., & Fernández-Manjón, B. (2013a). *E-Learning a escena: De La dama boba a Juego Serio*. IEEE RITA.
- Manero, B., Fernández-Vara, C., & Fernández-Manjón, B. (2013b). Stanislavky's system as a game design method: a case study. In *Proc. of DiGRA, defragging game studies*. Retrieved from <http://www.digra.org/digital-library/publications/stanislavkys-system-as-a-game-design-method-a-case-study/>.
- Mayo, M. J. (2009). Video games: a route to large-scale STEM education? *Science*, 323(5910), 79–82. <http://dx.doi.org/10.1126/science.1166900>.
- McFarlane, A., Sparrowhawk, A., & Heald, Y. (2002). *Report on the educational use of games*. TEEM: Teachers Evaluating Educational Multimedia.
- Ministerio de educación, cultura y deportes. (2008). *Escolarización y población*. Retrieved from <http://www.mecd.gob.es/dctm/ievaluacion/indicadores/2011-e1.2.pdf?documentId=0901e72b810b4d41>.
- Moreno-Ger, P., Burgos, D., Martínez-Ortiz, I., Sierra, J. L., & Fernández-Manjón, B. (2008). Educational game design for online education. *Computers in Human Behavior*, 24(6), 2530–2540.
- Munz, U., Schumm, P., Wiesebrock, A., & Allgower, F. (2007). Motivation and learning progress through educational games. *Industrial Electronics, IEEE Transactions on*, 54(6), 3141–3144.
- Padilla-Zea, N., Gutiérrez, F. L., López-Arcos, J. R., Abad-Arranz, A., & Paderewski, P. (2013). Modeling storytelling to be used in educational video games. *Computers in Human Behavior*, 31, 461–474.
- Palermo, U. de (2009). *Los adolescentes y los hábitos culturales*. Retrieved from http://www.palermo.edu/economicas/PDF_2010/Gallup/Losadolescentesyloshabitosculturales.pdf.
- Pallant, J. (2010). *SPSS survival manual: A step by step guide to data analysis using SPSS*. McGraw-Hill International.
- Papastergiou, M. (2009). Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers & Education*, 52(1), 1–12. <http://dx.doi.org/10.1016/j.compedu.2008.06.004>.
- Quero, M. (2002). *El enfoque de marketing relacional en entidades de servicios de exhibición de artes escénicas*. Universidad de Málaga.
- Ravenscroft, A. (2007). Promoting thinking and conceptual change with digital dialogue games. *Journal of Computer Assisted Learning*, 23(6), 453–465.
- SGAE. (2014). *Anuario SGAE sobre las artes escénicas 2014*. Retrieved from <http://www.anuariosgae.com/anuario2014/home.html>.
- Shute, V. J. (2011). Stealth assessment in computer-based games to support learning. *Computer Games and Instruction*, 55(2), 503–524.
- Sociedad General de autores y editores. (2012). *Anuario de las artes escénicas, musicales y audiovisuales 2012*. Retrieved from <http://www.anuariosgae.com/informe/pdfs/Conclusi.pdf>.
- Sung, H.-Y., & Hwang, G.-J. (2013). A collaborative game-based learning approach to improving students' learning performance in science courses. *Computers & Education*, 63, 43–51. <http://dx.doi.org/10.1016/j.compedu.2012.11.019>.
- Tuzun, H., Yilmazsoyulu, M., Karakus, T., Inal, Y., & Kizilkaya, G. (2009). The effects of computer games on primary school students' achievement and motivation in geography learning. *Computers & Education*, 52(1), 68–77. <http://dx.doi.org/10.1016/j.compedu.2008.06.008>.
- Universidad de Palermo, & TNS Gallup. (2009). *Los adolescentes y los hábitos culturales*. Buenos Aires, Argentina.
- Van Eck, R. (2007). Building artificially intelligent learning games. In D. Gibson, C. Aldrich, & M. Prensky (Eds.), *Games and simulations in online learning: Research and development frameworks* (pp. 271–307). Hershey, PA: Information Science.
- Wang, L., & Chen, M. (2010). The effects of game strategy and preference-matching on flow experience and programming performance in game-based learning. *Innovations in Education and Teaching International*, 47(1), 39–52.