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Research article

Do teachers believe that video games can improve learning?

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ABSTRACT

Although video games are increasing their presence in teens/children's private entertainment and there is ample evidence to support their educational possibilities, they are seldom introduced in classrooms. One of the least studied factors relative to the insertion of video games in curricula is teachers' conceptions on their effectiveness to foster learning. In this study, we investigate how teachers conceive of the educational usage of video games, considering their reported value and which video game dimensions are reflected to be of importance, as well as personal traits linked to them (gender, educational level, area of knowledge, teaching experience, behavioral intention ...). We designed a Likert questionnaire with three main dimensions: pragmatic play, epistemic play, and learning outcomes (verbal information, skills, and attitudes). 595 Spanish teachers answered the questionnaire online. We applied ANOVA and multiple regression techniques, which revealed a broad acceptance of video games as educational media. The most relevant analyzed factors turned out to be the intention to use video games in classrooms, and the private use of video games. Teachers believe that video games promote more learning when played with an epistemic goal, mediated by scaffolding and especially under the teacher's guidance, compared to pragmatic play related to completion and success in the game. They also consider video games to mainly promote verbal information learning, procedural learning, and finally attitude learning, with the latter being less probable. We suggest the need to strengthen not only teacher training programs in the educational use of video games but also research on relationships between teachers' beliefs and practices in order to convert these favorable beliefs into actual real practices.

1. Introduction

Video games (hereafter VG) are currently the most important cultural industry in economic impact, in good measure due to youngsters' recreational use. Likewise, several studies indicate that VG can favor a greater motivation and enjoyment towards learning in students (Hanus and Fox, 2015) which seems to be related to a certain positive attitude towards their use in school contexts (Bourgonjon et al., 2010; Martí-Parreño et al., 2018). In this way, itis no surprise that classrooms have been progressively incorporating them over the last decades, trying to favor students' interests and appealing to their aesthetic and fictional literacy. Several metanalyses (Boyle et al., 2016; Clark et al., 2016; Mayer, 2019; Qian and Clark, 2016) demonstrated major consequences in different *educational levels* and *areas* from using VG in teaching practices, whilst other authors conceive VG as instruments for social transformation, "games for change" social *behaviors* and *attitudes* (Burak and Parker, 2017). It has been widely studied that VG improve *verbal learnings* in STEM areas (Science, Technology, Engineering, and Mathematics), especially *factual knowledge* over *concept acquisition*. This is also the case in second language learning or even in professional contexts (Vigoroso et al., 2021). Some studies state that VG, and especially commercial off the shelf ones, have greater positive impacts when accompanied by scaffolding practices: instructional designs and interventions that mediate play (Clark et al., 2016) and which provide added values for learning (Barzilai and Blau, 2014; Mayer, 2019).

Direct mediation of instructional processes is therefore most significant when incorporating VG into formal education, but they are still hardly ever used (Ray et al., 2014). Ertmer (1999) identifies two types of resistance towards integrating technologies into teaching: first order barriers involve material resources at the educational institution (updated technologies, spaces, financial resources…), while second order barriers refer to *teachers' beliefs* and *conceptions* on the usability of each technology in the classroom. In the last two decades and according to Ertmer et al. (2015, p. 8), <<although first order barriers have been greatly reduced, second order barriers still prevent teachers from using technology to facilitate 21st century learning>>. This paper aims at

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studying how teachers conceive VG's capabilities for learning in educational spaces, analyzing plausible influences from different variables.

1.1. Teachers' beliefs about educational uses of VG

The role of beliefs in the ICT and, in particular, in the VG use is a fact widely contrasted by the literature. Various studies (Bourgonjon et al., 2010; de Grove et al., 2012; Ermert et al., 2012; Prestridge, 2012; Tondeur et al., 2017) point out that these positive beliefs have an impact on uses, even when there are external barriers to teachers that hinder them (Ertmer, 2005; Mama and Hennessy, 2010). In this way, different studies have shown that these beliefs are the best predictor of the use that can be expected of a digital resource (Ertmer, 2005; Ertmer et al., 2015). These beliefs are usually manifested in a behavioral intention to use the resource, which has a direct relationship with the use that is finally given to the resource used (Davis, 1986). Therefore, the behavioral intention is the variable best considered as a predictor of the actual use of VG in the classroom (Bourgonjon et al., 2013; de Grove et al., 2012). *Behavioral intention* can be defined as the subjective probability from an individual to perform a certain action (Fishbein and Ajzen, 1975). To measure this many researchers (Bourgonjon et al., 2013; Sánchez-Mena et al., 2019) used the Technology Acceptance Model developed by Davis (1986), which states usefulness and ease of use to be two influential variables on *behavioral intention* when people use technologies. The model defines usefulness as the perceived efficiency of a technological resource, while ease of use is the degree of effort associated with its application on a certain task.

In the last years, his model has been adapted specifically to know the grade of VG acceptance identifying other variables that impact the *behavioral intention* of using VG in the classroom.

For instance, De Grove et al. (2012) showed that the *frequency of VG recreational use* and *experience using VG in class* is positively related to their *behavioral intention*, while Sánchez-Mena et al. (2017) noted that *age* is negatively related.

In the same vein, some authors examine *teachers' attitudes* towards using VG in teaching instead of *behavioral intention*. These *attitudes* could be defined as positive or negative judgments that educators make about a certain resource, and they predict willingness of use. Accordingly, several variables have been identified in scientific literature as influential on *attitudes* towards VG for learning, i.e., *gender*, *age*, *teaching experience*, *educational level*, *area of knowledge*, learning theories, *or frequency of VG recreational use*.

Regarding gender and age, the results are not consistent. Alqurashi and Williams (2019) indicated women had better attitudes than men towards using VG in the classroom in contrast to the common thought that men have more positive *attitudes* toward ICT (Alrasheedi, 2009). While Noraddin and Kian (2014) could not find any gender differences by using different tests. The latter study stated the same for *teachers' ages*. Thus, it seems necessary to study if *gender* and *age* make some difference in how teachers conceive the educational use of VG. However, this study found changes when analyzing their *frequency of VG recreational use*. The more use was made of VG, the better the *attitudes* towards them, as De Grove et al. (2012) pointed out.

On other considerations related to teaching, Hsu et al. (2017) identified primary school teachers to have more positive *beliefs*, *confidence*, and *motivation* on VG educational use than their higher-level colleagues. Alqurashi and Williams (2019) were not able to find any difference in *teachers' attitudes* when considering *educational level*; nor could Noraddin and Kian (2014) on the grounds of the *area of knowledge*. It requires further study to know if these inconsistencies in *area* and *educational level* can be resolved. Additionally, Hsu et al. (2017) assessed *teaching experience* and concluded that teachers with the most experience consider VG to be a useful educational resource, but the least experienced were the most motivated towards applying VG in classrooms. It also generates doubts about the consistency of the relations between *teaching experience* and *teacher conceptions*. Both Noraddin and Kian and Alqurashi and Williams show similar results about the *teaching experience*. On the other hand, Alqurashi and Williams stated clear differences subject to learning theories held by teachers: those with constructivist stances were more favorable to VG use in classrooms as opposed to teachers closer to behaviorism theories. We should point out that teachers were asked about which posture they identified with, but the authors did not enquire into what *processes* and *learning outcomes* were associated with VG. These will be two of the main objectives of our study.

1.2. What is to Be learnt, and how, from VG?

As we have seen, nowadays there is a huge number of studies on what makes teachers inclined to bring VG into the classroom. But there are still very few reports on how teachers understand VG consequences in terms of *learning processes* and *outcomes*. This strongly differs from the larger research, mainly centered upon analyzing which VG characteristics influence those *learning outcomes* (Clark et al., 2016; Mayer, 2019).

Traditionally, research on VG has stressed the importance of their inherent *interactivity* as a means to reinforce learnings and ensure the necessary training for providing immediate feedback. This lets the player adjust his or her actions in real time depending on instant consequences, as well as obtaining contingent reinforcement via stimulation of the rewarding dopaminergic system in the brain (Howard Jones et al., 2011). Some studies have also stated that the higher the embodiment, the higher the learning (Malinverni and Pares, 2014), even in social VG requiring character identification where outcomes are more prominent when cognitive or emotional empathy is highly stimulated (Alhabash and Wise, 2012; Bachen et al., 2016).

We understand all these VG learning results in terms of the new embodied learning models, which assume implicit learning takes part in many learning processes (Pozo, 2017). According to 4E models (de Aldama, 2020; Rowlands, 2010), any activity is embodied by undergoing full body action, enactive by requiring *physical* or *psychological involvement* from the learner, embedded by being constantly context situated, and extended by being based on cultural and technological resources which sustain much of cognitive activity.

These 4E processes favor implicit learnings, especially associative ones (Pozo, 2017), and are pivotal for succeeding in many VG. But as we mentioned before, research on learning in educational spaces with these technologies emphasizes the importance of scaffolded activities (Clark et al., 2016; Mayer, 2019), which can be provided by teachers or included in the VG. This implies activating explicit learning processes to benefit reflection, deliberate exploration, and representational redescription (Barzilai and Blau, 2014; Karmiloff Smith, 1992; Pozo, 2017) on VG's actions and dynamics. Addressing the work of Kirsh and Maglio (1994) (also see Alderoqui and Pozo, 2013), players exhibit less learning when playing by the rules and purposes suggested by VG, following *pragmatic goals* aimed at succeeding compared to those who play through an instructional intervention and intend to develop new knowledge, following *epistemic goals* aimed at learning (Barzilai and Blau, 2014; de Aldama and Pozo, 2016).

Teachers seem to be conscious of the importance of his *epistemic factors* when their students use VG. For example, Huizenga et al. (2017), point out the importance which teachers give to elements such as *challenge* or feedback during the use of VG. Thus, we consider that teachers value positively these VG characteristics.

In this sense, it is worth asking ourselves which *conceptions* are teachers holding about VG mediated learning processes and which variables are related? Do sociodemographic or professional variables influence their *beliefs* on VG usage in classrooms, or are they more determined by *habits and attitudes*? Do they believe VG to be sufficient for learning thanks to implicit processes? Or on the contrary, and aligned with research, do they exhibit more reliance on scaffolding VG, so they promote constructive and complex learning?

Whilst VG for "change the world" (Burak and Parker, 2017) are designed as self-sufficient tools, which do not need additional

educational intervention or scaffolding beyond their *pragmatic goals*, most research points that for fulfilling their goals of change it is necessary an additional instructional intervention oriented to *epistemic* or learning knowledge goals.

Concerning *learning outcomes* of VG, as we expressed earlier, research shows VG in educational spaces provide mainly *verbal learnings*, more *factual* than *conceptual* (Boyle et al., 2016; Clark et al., 2016). Some studies also focus on VG enhancing certain cognitive processes such as attention, spatial cognition, or speed of processing (Bediou et al., 2018; Dye et al., 2009), whereas others deem VG as being detrimental for youngsters' *attentional and processing abilities* (Bavelier et al., 2011; Greenfield, 2014). There is also some research on VG promoting *prosocial attitudes* (Greitemeyer and Mügge, 2014; Passmore and Holder, 2014), opposed to the widespread conclusion that VG encourage aggressive or unsuited behavior, loneliness, and social irresponsibility (Anderson et al., 2010; Bavelier et al., 2011; Gollwitzer and Melzer, 2012). What *learning outcomes* do teachers consider more prominent from VG? Do they hold the view that VG foster *prosocial attitudes* or violent behavior (Greitemeyer et al., 2010)?

As educational practices are still mostly oriented to specific domain *verbal learning* (Pozo et al., 2021) and also the educational use of VG promotes above all *verbal learning,* we should expect teachers to also conceive this goal as a priority. In contrast, we consider that *attitudinal learning* will be less considered for two reasons: the first one, because there is a *traditional belief* of that VG favor antisocial behavior (Anderson et al., 2010; Bavelier et al., 2011) and the second one because *attitudinal learning* is the goal which traditionally has been less taught in schools (Martín, 2006).

Accounting for the controversy on how VG influence cognitive processing (Mayer, 2019; Quian and Clark, 2016), it is interesting to ask teachers about their *beliefs* on this topic too.

Finally, despite most "VG for change" are directed to promote *attitudinal* or *behavioral changes* in gamers, teachers may assume the extended *belief* that VG rather contribute to *antisocial* or *individualist attitudes*.

2. Objectives

This study focuses on four main objectives:

1. Determining *teachers' beliefs* on whether VG promote learning in educational spaces and which independent variables (*gender*, *educational level*, *teaching experience*, *frequency of VG recreational use and frequency of VG use in the classroom*) are related to them.
2. Analyzing which independent variables influence the *behavioral intention* for applying VG in the classroom and which variables covariate with *behavioral intention.*
3. Assessing which VG dimensions, either *pragmatic*, related to 4E learning, or *epistemic*, related to scaffolding, are considered by teachers to improve learning. Besides, analyzing which variables influence these *conceptions*, their interactions, and potential group differences.
4. Assessing *teachers' beliefs* on which *learning outcomes* are better learned from VG, *verbal*, *procedural*, or *attitudinal*, as well as analyzing which variables influence these *conceptions*, their interactions, and potential group differences.

3. Material and methods

3.1. Task and procedure

To fulfill these objectives, we designed a two-part questionnaire. The first part, after accepting the corresponding informed consent, asked for personal and professional data (*gender*, *teaching experience*, *educational level*, *area of knowledge*), and information regarding VG *habits and attitudes* (*frequency of VG use in the classroom, frequency of VG recreational use,* and *behavioral intention* to use VG in the classroom). The second part comprised 60 statements on how VG could benefit or hinder learning. Teachers were requested to state their level of agreement to these statements on a 6-point Likert scale.

We designed those 60 items based on the principal components for every teaching/learning process: *conditions*, *processes,* and *outcomes* (Cabellos et al., 2021). In this case, *conditions* referred to VG's inherent traits or usage context, and *processes* were presented as the psychological activity manifested by the player. In both cases, we differentiated between those oriented to *pragmatic learning* (achieved via associative processes initiated by VG) and those oriented to *epistemic learning* (requiring self-regulation and reflection on events presented in VG). In turn, *outcomes* referred to what can be learned from VG: *verbal learnings* (*data* and *concepts*), *procedural learnings* (skills and processes), and *attitudinal learnings* (social behavior).

Consequently, our questionnaire consisted of 3 main dimensions: *pragmatic learning*, *epistemic learning*, and *learning outcomes*; divided into 17 subdimensions which are compounded by 4 items (2 positives and 2 negatives for avoiding the acquiescence bias). To ensure content validity, we carried out an item dimension pairing task executed by a panel of 8 expert judges which proved 2 subdimensions were flawed. Finally, the questionnaire comprised 15 subdimensions: 4 in *pragmatic learning*, 5 in *epistemic learning*, and 6 in *learning outcomes* (Table 1).

3.2. Participants

We generated the questionnaire using the Qualtrics platform and sent it via email to many schools across Spain. The study was approved by the Research Ethics Committee of Autonomous University of Madrid. To motivate participation, we raffled 75€ in teaching materials. The questionnaire was completed by 614 teachers from the formal education system. All teachers gave the informed consent to participate in the study.

This sample was recollected from January 29th, 2020, to April 2nd, 2020, before the school lockdowns as a consequence of the COVID-19 pandemic. From this initial sample, we eliminated 10 respondents who completed the survey in less than 5 min, and 9 respondents who answered in an unreliable pattern (mean differences equal or higher than 1.5 between positive and negative items). This resulted in a final sample of 595 participants. Table 2 shows the personal and professional information of participants.

3.3. Data analysis

To ensure each subdimension was internally consistent, we conducted a reliability analysis with Cronbach's alpha coefficient, which showed $\alpha \geq .7$ for 11 of 15 subdimensions. For the remaining ones, *motivation*, *challenge*, *teacher supervision*, and *prior knowledge*, the first three could be improved by removing one item from each, resulting in no subdimension with $\alpha < .65$.

Once we removed those three items, we applied a reliability analysis on each dimension (*pragmatic learning*, *epistemic learning*, and *learning outcomes*), and every subdimension from the last (*verbal learnings, procedural learnings,* and *attitudinal learnings*). In each case, Cronbach's alpha was higher than .8. Reliability for the final scale (57 items) was $\alpha = .97$.

In order to apply further analysis, we made each dimension and subdimension operational by calculating the average of the items' values. We also calculated the average amount of all items to estimate the standard *beliefs* on learning with VG.

We performed one way and two-way ANOVA for objectives 1, 3, and 4; and ordinal regression analysis for objective 2. We conducted post hoc group analysis by applying Bonferroni correction.

4. Results

We will organize the presentation of the results using the four principal objectives of the study.

Table 1. Questionnaire subdimensions.

		Subdimension	Item examples
Pragmatic learning		Physical involvement	By having to perform physical actions to play a VG, learning is improved (+).
		Emotional involvement	Getting accustomed to the character's point of view restrains learning (-).
		Interactivity	Seeing immediate consequences when playing a VG improves learning (+).
		Goal Motivation	Setting additional goals different from those stated in the VG restrains learning (-).
Epistemic learning		Personalization	Being able to solve problems at the player's pace improves learning (+).
		Challenge	By facing tasks in which the player frequently fails, learning is restrained (-).
		Teacher supervision	When teachers provide additional knowledge concerning subjects present in the VG, learning is improved (+).
		Prior knowledge	Having to apply any kind of prior knowledge when playing a VG restrains learning (-).
		Metacognitive control	Planning, supervising, and consciously adjusting which actions are performed when playing a VG improves learning (+).
Learning outcomes	Verbal	Data learning	It is difficult to learn multiplication tables from a VG (-).
		Conceptual learning	Practicing different contents in a VG helps to understand hard to grasp concepts (+).
	Procedural	Attentional learning	The amount of information that VG show produces attentional issues in daily life (-).
		Transfer	VG favor applying their contents and concepts to analogous daily life situations (+).
	Attitudinal	Integration and participation	Playing VG makes a person less sociable in everyday life (-).
		Attitudes of tolerance and respect	VG help to assimilate values of tolerance towards different groups and individuals (+).

* As the items referred to the dimension in positive or negative form, the code (+) indicates positive examples and the code (-) negative ones.

Table 2. Personal and professional participant information.

Variables	N	Categories	N	Valid percentage
Gender	587	Men	203	34.58
		Women	384	65.42
Age	595	35 or less	171	28.74
		36 to 50	290	48.74
		Over 50	134	22.52
Teaching experience	594	From 0 to 9 years	192	32.32
		From 10 to 19 years	170	28.62
		20 years or more	232	39.06
Educational level	514	Preschool and Primary	232	45.14
		Secondary and Vocational	195	37.94
		Post-secondary	87	16.93
Primary school knowledge area	165	Mentors	112	67.88
		Support	14	8.48
		Specialized (Music, Phys. Ed. and English)	39	23.64
Secondary school knowledge area	159	STEM	80	50.31
		Social Studies	16	10.96
		Communication	36	22.64
		Others	27	16.98
Frequency of VG recreational use	595	Never	344	57.82
		Several days a month	150	25.21
		Several days a week or higher	101	16.97
Frequency of VG use in the classroom	594	Never	405	68.18
		In less than half of the school year's program	154	25.93
		In half or more of the school year's program	35	5.89
Behavioral intention	595	No intention to use VG in classroom	255	42.86
		Maybe will use VG in classroom	241	40.50
		Definitely will use VG in classroom	99	16.64

4.1. Objective 1. Do teachers believe that VG can promote learning?

We found a positive assessment of teachers on learning with VG ($M = 4.41$, $SD = 0.76$). However, is this favorable position affected by the independent variables considered in this study? We only found significant differences according to *gender*, $F(1,586) = 6.24$, $p < .05$, $\eta_p^2 = .01$, being men ($M = 4.52$, $SD = 0.79$) more favorable than women ($M = 4.35$, $SD = 0.73$); *frequency of VG recreational use*, $F(2,592) = 22.18$, $p < .001$, $\eta_p^2 = .07$; *frequency of VG use in the classroom*, $F(2,591) = 12.61$, $p < .001$, $\eta_p^2 = .04$, and especially *behavioral intention*, which showed the greatest effects, $F(2,592) = 53.39$, $p < .001$, $\eta_p^2 = .15$. In these last three independent variables, we found a positive linear relationship regarding *beliefs* for the use of VG (*in recreational use*, $F(2,592) = 45.84$, $p < .001$; for the *use of VG in the classroom*, $F(2,591) = 23.86$, $p < .001$; and for the *behavioral intention*, $F(2,592) = 105.01$, $p < .001$. In contrast, we found no differences based on *teaching experience*, *area of knowledge*, or *educational level*.

We also considered the correlations between these variables. For this, we carried out a two factor ANOVA which showed that *gender* and *frequency of VG use in the classroom* were no longer significant in the presence of the *behavioral intention* variable. Based on this criterion, we performed a completely randomized two factor ANOVA showing that *behavioral intention* and *frequency of VG recreational use* explained 18.1% of the model variance. Regarding the contribution made by each variable, we note that *behavioral intention*, $F(2,586) = 23.58$, $p < .001$, $\eta_p^2 = .07$, affected to the *teachers' belief* about the possibilities of learning with VG more than *frequency of VG recreational use*, $F(2,586) = 7.13$, $p < .001$, $\eta_p^2 = .02$.

In short, according to other previous studies, *behavioral intention* is the variable that most influences teachers' beliefs, so it is interesting to analyze which variables make this *behavioral intention* more probable.

4.2. Objective 2. What variables influence behavioral intention of using VG?

To answer this question, we conducted an ordinal regression analysis in which we introduced the following independent variables: *gender*, *educational level*, *area of knowledge*, *age*, *teaching experience*, *frequency of VG recreational use*, and *frequency of VG use in the classroom*. Only the *frequency of VG use in the classroom* and the *frequency of VG recreational use* provided significant results, so the rest of the variables were excluded from the model. Finally, we got a regression that explained the 38.6% of the variance thanks to these variables. In both cases we identified a direct and positive relationship between the *frequency of VG use* and *behavioral intention*, being greater the influence of the *frequency of VG use in the*

classroom, $Z_{Wald} = 149.18$, $p < .001$, $E = 2.17$, than the *frequency of VG recreational use*, $Z_{Wald} = 25.09$, $p < .001$, $E = 0.56$.

We also wondered whether the *frequency of use in class* or the *frequency of VG recreational use* depended on other variables. For this purpose, we carried out two ordinal regressions. The regression that best explained the changes produced in the *frequency of VG recreational use* was formed by the *age* and *gender* variables, explaining 12.4% of the variance in the dependent variable. In the case of *age*, there was a negative linear relationship, so that the higher *age* of the teachers, the lower the *frequency of VG recreational use*, $Z_{Wald} = 34.88$, $p < .001$, $E = -0.49$. In the case of *gender*, women played less than men in their *free time*, $Z_{Wald} = 30.07$, $p < .001$, $E = -0.946$.

The regression that analyses the changes in the *frequency of VG use in the classroom* showed that belonging to the social area in secondary school explained 7.2 % of the use of VG in the classroom, $Z_{Wald} = 9.94$, $p = .004$, $E = 1.62$.

In summary, the *behavioral intention* of using VG in the classroom is explained by the *frequency of VG recreational use* and especially by the *frequency of VG use in the classroom*. Besides, younger *age* is identified as a predictor of VG recreational use as well as being men. Finally, it seemed that belonging to the social sciences area could influence the increased use of VG in the classroom.

From these data, we should ask ourselves about *teachers' beliefs* on what makes VG effective for learning. For this purpose, it is necessary to compare *beliefs* about the different dimensions and subdimensions of the questionnaire.

4.3. Objective 3. What dimensions of VG, either pragmatic, epistemic, or both, do teachers believe facilitate learning?

To carry out this objective, we compared the *pragmatic* and *epistemic* dimensions. In other words, we analyzed whether teachers believe that the *pragmatic goals* promoted by the VG are sufficient for learning or if, on the contrary, they consider that instructional mediation is necessary to promote *epistemic goals*. For that purpose, we conducted a repeated measures ANOVA. We found that teachers considered less relevant for learning the *pragmatic goals* ($M = 4.49$, $SD = 0.81$) than *epistemic goals* ($M = 4.63$, $SD = 0.72$), with a significant difference and a high effect size, $F(1,594) = 109.88$, $p < .001$, $\eta_p^2 = .16$ (see Figure 1).

On the strength of this, we were interested in knowing whether this preference for *epistemic* versus *pragmatic play* depended on some variables considered in the study. We analyzed the effects of interaction through the study of mean differences in the *pragmatic* and *epistemic* dimensions and the influence of different demographic variables. These analyses showed significant results when the *gender* variable was introduced, $F(1,1172) = 4.53$, $p < .05$, $\eta_p^2 = .01$; *teaching experience*, $F(2,1782) = 4.99$, $p < .01$, $\eta_p^2 = .02$; *frequency of VG recreational use*, $F(2,1785) = 10.35$, $p < .01$, $\eta_p^2 = .03$; and *behavioral intention*, $F(2,1785) = 7.93$, $p < .01$, $\eta_p^2 = .03$. However, the effect sizes were small, and the mean was always greater in the *epistemic* dimension than the *pragmatic* one in each analysis. We found no effects in terms of *area of knowledge*, *educational level*, or *frequency of VG use in the classroom*.

In the case of *gender*, there were fewer differences between *pragmatic* and *epistemic play* in men than in women ($p < .05$). There were also fewer differences between teachers with less *experience* than those teachers with more *experience* ($p < .05$). When we introduced the *frequency of VG recreational use*, the differences between *pragmatic* and *epistemic* were greater in the groups that played less than the groups that most frequently played ($p < .001$) (see example in Figure 2). Finally, introducing the *behavioral intention* to see the differences between the *epistemic* and *pragmatic dimensions*, we observed that the groups who did not have *behavioral intention* had more differences between both dimensions than the groups which had it ($p < .05$).

However, although the differences between the *epistemic* and *pragmatic dimensions* varied when we introduced the independent variables, only in the *frequency of VG recreational use*, and specifically for the individuals who played the most, was the difference between the *epistemic* and *pragmatic dimensions* no longer significant ($MD = 0.01$, $SD = 0.34$, $p = .675$) (see Figure 2). Concerning *gender*, *teaching experience*, and *behavioral intention*, despite the interaction, in all groups regardless of these variables *epistemic play* got higher scores than *pragmatic play* ($p < .05$).

We asked ourselves whether these differences between dimensions could be caused by some specific subdimension. We observed significant differences between these subdimensions, both in the case of *pragmatic learning*, $F(3,1782) = 26.89$, $p < .001$, $\eta_p^2 = .04$, and *epistemic learning*, $F(4.2376) = 71.65$, $p < .001$, $\eta_p^2 = .11$.

leftIn the *pragmatic* subdimensions (see Figure 3), teachers attributed less learning to *physical* and *emotional involvement* than *interactivity* and *motivation* ($p < .001$ in all cases).

centerIn the *epistemic* dimension, teachers considered that *teacher supervision* and *metacognitive control* were more important than *personalization*, *challenge*, and *prior knowledge* ($p < .001$ in all cases). However, teachers mostly emphasized the effect of *teacher supervision* on educational learning with VG (see Figure 4).

In conclusion, it seems that regarding their *conception* of the efficacy of VG in learning teachers attach greater importance to elements that allow them to orient their students to *epistemic goals*, with small differences according to some personal variables such as the *frequency of VG recreational use* or *teaching experience*.

Regarding the *pragmatic* components of VG, *physical* and *emotional involvement* are the least valued, whilst the most highly valued are *interactivity* and *motivation*. As for the *epistemic* ones, *teacher supervision* is highly valued while the contribution of *prior knowledge* or *personalization* seems to be less important for them.

Having considered these factors on the uses and conditions of VG, it now remains to investigate into which *areas of knowledge* and education VG are more valid for teachers.

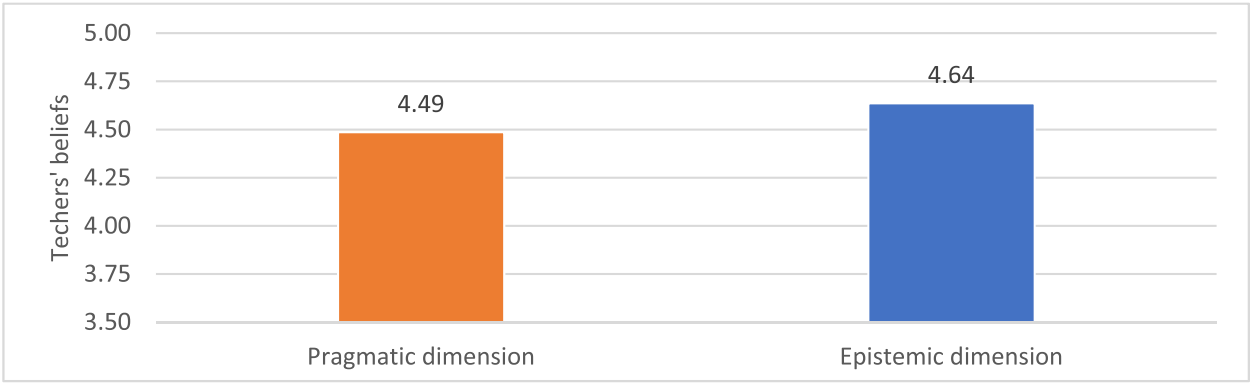

Figure 1. Means of the pragmatic and epistemic dimension.

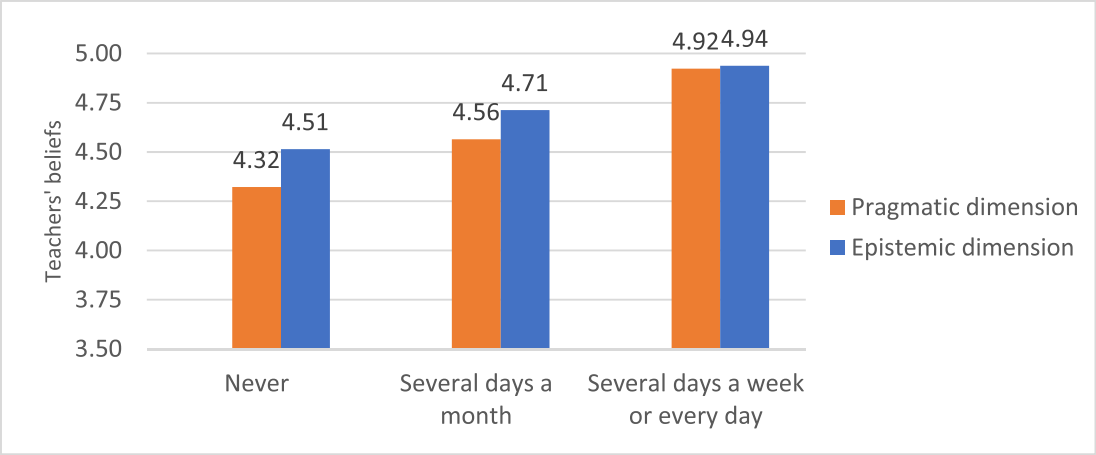

Figure 2. Effect of the interaction in the frequency of VG recreational use and the mean differences between the epistemic and pragmatic dimensions.

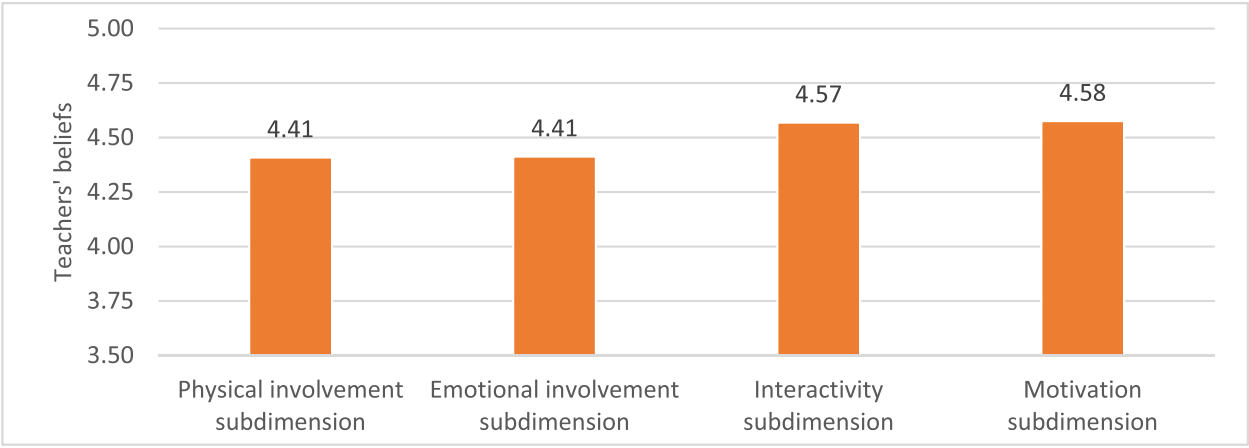

Figure 3. Means of the subdimensions in the pragmatic dimension.

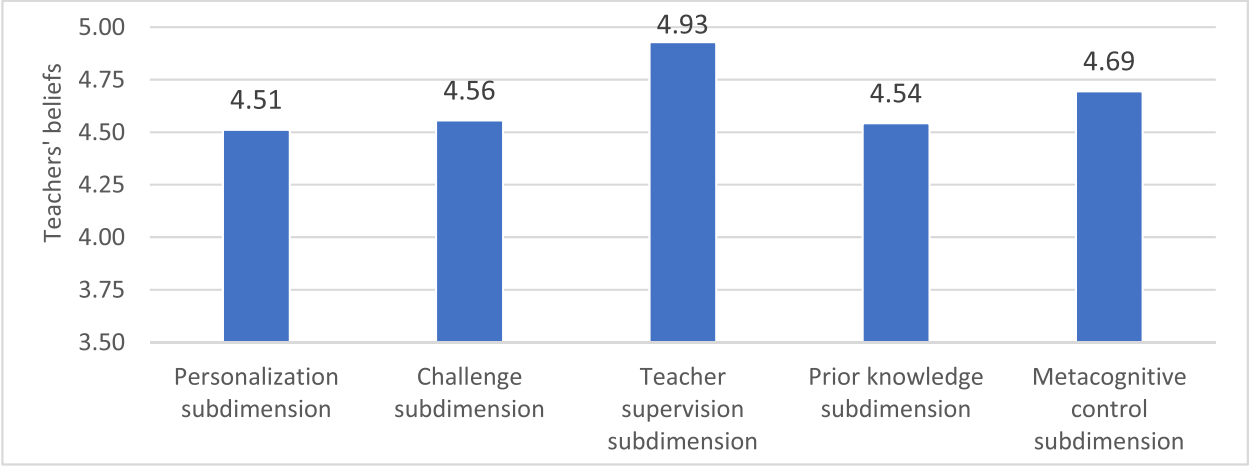

Figure 4. Means of the subdimensions in the epistemic dimension.

4.4. Objective 4. What learning outcomes do teachers believe that VG can facilitate as an educational resource? What variables modulate these beliefs?

To check which learning (*verbal*, *procedural*, or *attitudinal*) the teachers believed their pupils were most likely to get with VG, we conducted repeated measures ANOVA. The results showed that the most expected was *verbal learning* ($M = 4.54$, $SD = 0.03$), then *procedural learning* ($M = 4.29$, $SD = 0.04$) and finally *attitudinal learning* ($M = 3.78$, $SD = 0.04$). These differences were significant and had a considerable effect size, $F(2,1188) = 375.67$, $p < .001$, $\eta_p^2 = .56$). Post hoc analyses showed significant differences ($p < .001$) when we compare *verbal*,

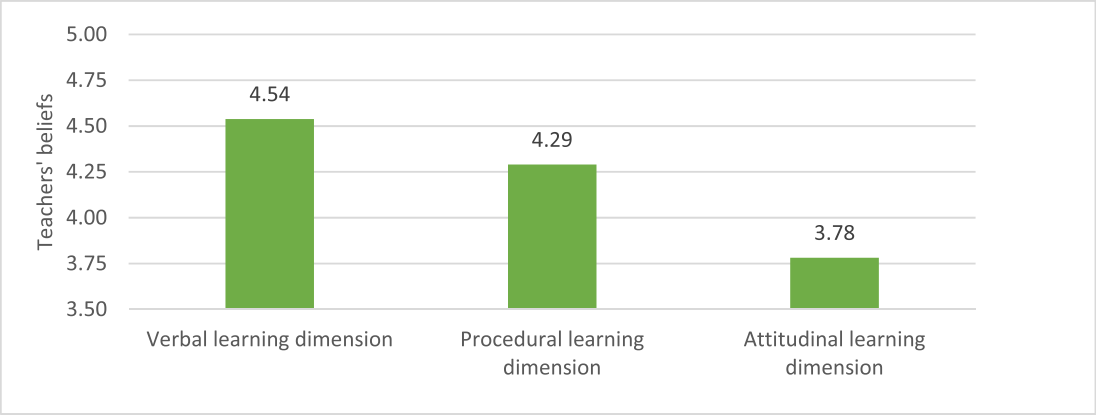

Figure 5. Means of the different types of outcomes which according to the teachers may be obtained by VG usage.

procedural, and *attitudinal* dimensions among them (see Figure 5). Therefore, teachers believe that VG have different possibilities depending on the *learning outcome* sought.

As we did before, we analyzed influences of demographic variables on these differences. The frequencies of the *VG recreational use*, of the *VG use in classroom*, and the *behavioral intention* favored the assessment of *verbal learning*, $F(2,1782) = 31.65$, $p < .001$ for the *frequency of VG recreational use*, $F(2,1782) = 19.55$, $p < .001$ for the *frequency of VG use in the classroom*, and $F(2,1782) = 83.66$, $p < .001$ for the *behavioral intention*; *procedural learning*, $F(2,1782) = 39.17$, $p < .001$ for the *frequency VG recreational use*, $F(2,1782) = 19.39$, $p < .001$ for the *frequency of VG use in the classroom*, and $F(2,1782) = 89.59$, $p < .001$ for the *behavioral intention*; and *attitudinal learning*, $F(2,1782) = 39.17$, $p < .001$ for the *frequency of VG recreational use*, $F(2,1782) = 19.39$, $p < .001$) for the *frequency of use in the classroom*, and $F(2,1782) = 89.59$, $p < .001$ for the *behavioral intention*). We also identified that men were more favorable than women in the *procedural* ($p < .01$) and *attitudinal* ($p < .05$) *learning*. However, we got no differences when we introduced the *experience*, the *educational level*, or the *area of knowledge* in the model.

When we analyzed the effect of the interaction between learning and the sociodemographic variables involved, we observed significant differences in *gender*, $F(2,2344) = 8.91$, $p > .000$, $\eta_p^2 = .02$, and *educational level*, $F(4,3078) = 3.16$, $p > .05$, $\eta_p^2 = .01$. However, these differences were insignificant. Therefore, we did not consider them in subsequent analysis. In view of these effects, we separately calculated the differences between the different subdimensions in the *verbal*, *procedural,* and *attitudinal learnings* dimensions (see Figure 6). In the *verbal learnings*, the differences between *data* and *conceptual learning* ($M = 4.78$, $SD = 0.04$; $M = 4.30$, $SD = 0.04$) were significant $F(1, 594) = 300.29$, $p < .000$, $\eta_p^2 = .34$). Regarding the *procedural* ones, the mean differences between the *attentional learning* and *transfer* subdimensions were not significant. Finally, the differences between the *attitudinal, integration and participation* ($M = 3.61$, $SD = 0.97$) and the *attitudes of tolerance and* respect ($M = 4.00$, $SD = 1.02$), were significant and had a high effect on size, $F(1,594) = 115.38$, $p < .001$, $\eta_p^2 = .16$).

5. Discussion and conclusions

We will now return to each of the objectives of this study and, based on the results we have described, reconsider some theoretical approaches presented in the introduction.

Concerning the first objective –if teachers consider that VG help learning in educational contexts– our results support the data from previous research carried out in our country (Marín-Díaz et al., 2019; Sánchez-Mena et al., 2017) as well as in other countries (Alqurashi and Williams, 2019; Bourgonjon et al., 2013; Hsu et al., 2017): teachers are in

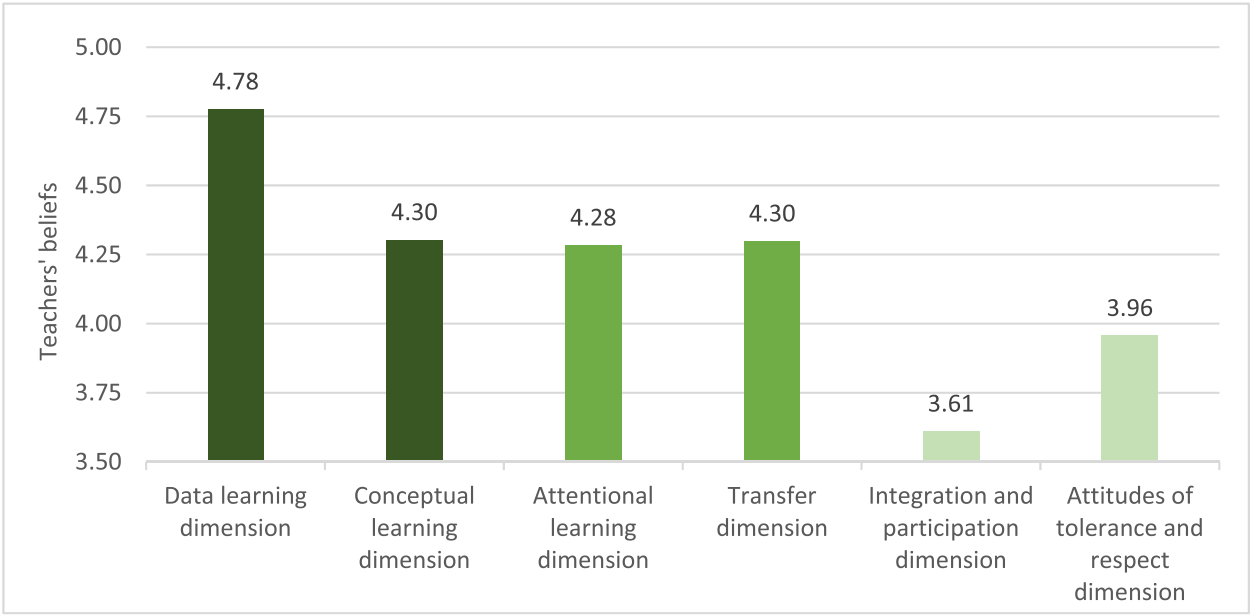

Figure 6. Means of the subdimensions for each type of outcomes.

favor of VG educational use in general. This clashes with low use in educational contexts as some studies have shown (Ray et al., 2014).

The variables that best predicted being in favor of learning with VG were the *frequency of VG recreational use* and above all *behavioral intention*. These results are consistent with studies that claim that *behavioral intention* is an important variable when the use of VG in the classroom is considered (Bourgonjon et al., 2013; de Grove et al., 2012; Sánchez-Mena et al., 2017, 2019).

In the second objective, we analyzed which variables predicted *behavioral intention*. We observed that the *frequency of VG recreational use* and especially the *frequency of VG use in the classroom* explained 38.6% of the variance in *behavioral intention*. This data contrasts with the scarce effect that the *frequency of VG use in the classroom* had on *teaching beliefs*. In our opinion, it could be explained by the correlation of this variable with *behavioral intention*, which particularly affected the *teachers' beliefs* (objective 1). This last variable would have eclipsed the effect of the *frequency of VG use in the classroom* on *teachers' beliefs*.

Nevertheless, this importance of *frequency of VG use in the classroom* has already been identified in others research such as in de Grove et al. (2012). Likewise, the *frequency of VG recreational use* also has been a variable with an effect on the *attitudes* of the teacher regarding VG use (Noraddin and Kian, 2014).

But what variables increase the *frequency of play in the classroom* and the *frequency of VG recreational use*? In the *frequency of VG recreational use*, *age* and *gender* explained 12.4% of the variance. The oldest teachers were those who used less VG in leisure contexts. Likewise, men played more than women in their free time.

This influence of both variables on the *frequency of VG recreational use* is compatible with other previous studies in which were obtained similar results. In *gender*, some studies have already pointed out that men played VG more than women (Griffiths et al., 2004; Howe et al., 2019). A possible explanation for this is that VG usually are focus on men audience. Fortunately, each time there are more VG that include women among their public and are developed with a gender perspective. This fact is reflected in the increase of women gamers in the last years. On the other hand, regarding *age*, some researchers have pointed out that youngers were the population that spends more time using them (Howe et al., 2019). This fact is widely justified for the more common use that young people do of ICT, and not only VG, due to them having grown with these devices.

On the frequency of VG use in the classroom, being a teacher in the field of social sciences explained 7.2 % of the variance. An explanation for this data would be the fictional structure of many commercial VG, which represent real social systems and facilitate their use and discussion for the learning of social sciences content (Gee, 2003).

Games such as *Civilization* (Charsky and Ressler, 2011; Squire et al., 2008) or *Assassin's Creed* (Vicent and Platas-Mendaza, 2018) are widely known for their potential for learning social sciences.

We also studied the VG aspects that teachers considered more effective for learning. We found that teachers believe that the *epistemic approach* in the use of VG, related to instruction and explicitly directed toward educational goals, promote more learning than the *pragmatic approach*, related to intrinsic properties of VG such as *interactivity*, *personalization*, or *physical* or *psychological involvement*. Therefore, they do not believe that VG are sufficient in themselves to learn, but that they need to include scaffolding for this when students use them, as several metaanalyses have shown (Clark et al., 2016; Mayer, 2019). These works provide evidence that scaffolding favors learning with VG. Scaffolding allows us to focus on the specifics events of the VG which are important for learning and provides the extra content necessary for generating explicit knowledge starting on the implicit representations generated by the VG. Specifically, the most important dimensions for teachers are *metacognitive control* and *teacher supervision*. For them, VG are effective when they promote in their students a metacognitive activity and it is mostly achieved when the activity is supervised by the teacher. These *beliefs* are supported by several studies about the educational use of VG that show that learning is greater when there is a scaffolding that promotes such metacognitive activity (Clark et al., 2016; Mayer, 2019).

In contrast, other dimensions intrinsic to the dynamics of VG, such as *physical* and *emotional involvement*, or *motivation*, do not play such an important role in learning like the ones cited above, according to teachers. This contrasts with scientific literature which often advocates these dimensions are important for learning because they consolidate their *pragmatic use* (immersion and success orientation) (Bachen et al., 2016; Huizenga et al., 2017; Malinverni and Pares, 2014).

To sum up, playing with *epistemic goals* seems more effective than playing for *pragmatic goals* (for fun, to "beat" the game), a belief also supported by some studies (Barzilai and Blau, 2014; de Aldama and Pozo, 2020).

In the case of teachers more accustomed to the use of VG in their *free time* and with a greater *behavioral intention*, this difference between *epistemic* and *pragmatic* decreases. These teachers with more *experience* and *knowledge of VG* believe more in the intrinsic properties of *pragmatic play*, although they also consider *epistemic* aspects are necessary. The more they know about VG, the more they value their dynamics as resources for learning, which could be related to the *self-efficacy perception* (Hsu et al., 2017, 2020). Our viewpoint is that this *self-perceived competence* would be related to *teachers' beliefs* about learning with VG, analyzed in this study. In these papers about *self-efficacy perception*, factors like youth (a younger *age* or less *experience*) are identified as variables that affect positively this perception of competence on using VG. However, in our case, it does not seem that being young (operationalized as *experience*) affects *teachers' beliefs*.

An explanation for this data would be the scarce presence of VG in teacher training in Spain (Cabellos et al., 2021; Conde-Cortabitarte et al., 2020; Gros, 2012), which has not increased in recent years although research in recent years shows that teacher training in VG improves both *conceptions* and the *perception of competence* in its use (An and Cao, 2017; Kenny and McDaniel, 2011) highlighting the need to promote training in this area. Instruction should affect educational practices with VG. As a result, the *teachers' previous conceptions* would be apparent and their modification through reflective practices could be forwarded (Martín and Cervi, 2006; Schön, 1982).

In the fourth objective of our study, we analyzed *teachers' beliefs* about the kind of learning that could be achieved through VG. We found that teachers assume that *verbal learning* is the easiest to achieve, followed by *procedural* and finally *attitudinal learning*. Therefore, we see teachers focus more on *data* and *conceptual learning*, as in most of the research on the educational use of VG (Boyle et al., 2016; Clark et al., 2016; Vigoroso et al., 2021). This kind of learning represents a huge part of the content in the traditional curriculum, specifically the lower-level *verbal learning* (*data learning*) instead of more complex learning (*concept understanding*).

In contrast, teachers have less confidence in the use of VG to promote information processing in terms of *attentional resources* and *control of cognitive processes*, which were the focus of the *procedural dimension* in this study. This fact is notable due to there are some studies that point out the good results of VG to promote procedural learning. For instance, Parong et al. (2017) used a VG called *Alien Game* getting an improvement in shifting attention from one task to other. In the same way, Boot et al. (2008) identified higher scores on mental rotation tests of two-dimensional shapes after playing *Tetris*.

Finally, the *learning outcomes* least expected by teachers, within the positive assessment, are the *attitudes and learning of social behaviors* (specifically *integration and participation*, and *attitudes of tolerance and respect*). Teachers seem to share the skepticism of those who consider, with greater or lesser empirical support, that VG are not the best resource to promote socialization (Anderson et al., 2010; Bavelier et al., 2011; Greenfield, 2014) in contrast to researchers who have shown that certain VG designed for *attitudinal learning* can promote prosocial behaviors in players, improve mood, and generate positive feelings (see Greitemeyer et al., 2010; Passmore and Holder, 2016). From our perspective, specific

teacher training in the use of prosocial VG may help to change the image of how VG aid socialization.

In summary, the results of our study support the need to promote greater teacher training in the educational use of VG if we want to incorporate them as teaching resources. Teachers most familiar with them have a greater *behavioral intention* but also a more positive evaluation of their educational effectiveness because of their intrinsic properties (*pragmatic play*) and workable *epistemic uses*. This is not a one-way causal chain, but familiarity and favorable disposition are likely to feed off each other. Therefore, there is a need not only to familiarize teachers with VG but also to provide specific training to develop the necessary skills required for using them in class. Concerning this need to strengthen such teacher training, the data also raises another important question. If teachers are in favor of the educational use of VG, why does this provision not imply a greater actual use in the classroom? 68.18 % of the participants claimed in this study that they had never used VG in the classroom to promote their students' learning (as Table 2 shows). We could find an explanation for this in the lack of training in the use of such resources or even in the so called first order barriers (Ertmer, 1999), i.e., the limitation in technological resources, time, or space to introduce VG in the classrooms.

However, according to Ertmer et al. (2015), the essential barriers to integrating ICT in classrooms are not so much associated with external or first order barriers, as the *teachers' conceptions* and practices themselves, or second order, which were analyzed in this study. In the specific case of VG, de Grove et al. (2012) found that it is not the material barriers, but those related to the beliefs that limit its integration. In this sense, different studies have reported that teachers' conceptions usually do not correspond to the ICT uses that they make in class (Berger et al., 2018; Kaymakamoglu, 2018; OECD, 2009). This fact could explain the discrepancies between the positive conceptions towards VG use and its lack of use. Several studies have shown that teachers when using digital resources manifest practices content centered (Brun and Hinostroza, 2014; Mailizar and Fan, 2020; Pozo et al., 2021; Sigalés et al., 2008), even when they point out the opportunities of student-centered teaching (Kaymakamoglu, 2018; Pérez Echeverría et al., 2022). This fact seems to be reflected in the lack of VG use since, by their own characteristics, are not resources that allow this centered-content teaching but require the active uses of the student from which to reflect on the events and consequences of the actions that are carried out with them. At this point, we would like to add that this content-centered conception even is evidenced in pre-service teachers. Cabellos et al. (2021) identified fewer positive conceptions towards using VG as a learning resource in pre-service teachers than in students from other knowledge fields, which seems to be related to this conception of content-centered teaching.

Therefore, despite positive *beliefs* about VG of this study we think that to convert the favorable disposition of the teacher towards VG into effective practices, it is necessary to promote training with these resources. From our position, this training should be oriented not only to improve the teachers' competencies when using VG, seeking the understanding and integration of the pragmatic and epistemic elements that underlie practices with these resources, but also should be oriented to help teachers to rethink their role in teaching (Pérez Echeverría et al., 2022; Pozo et al., 2021; Sánchez-Cruzado et al., 2021). In this sense, the need to promote uses with the VG that are oriented to student-centered activities is essential in today's society.

Finally, this training should be aimed at integrating these practices into the curriculum. There is a need to create an educational culture in schools that specifically integrate VG as one more element in curriculum development. In this sense, our results have shown the specific necessity of making teachers reflect on the use of VG with other goals apart from *factual learning*. According to Ertmer et al. (2015), the integration of ICT requires student-centered teaching, which assumes training in the 21st Century competencies, including new attitudes and improving the way they process information through ICT.

In short, the results show the importance of teachers becoming familiar with the use of VG, especially in educational contexts, since this promotes more positive conceptions of VG use in the classroom. This involvement should be considered in teacher training programs (Rüth et al., 2022). In fact, some studies (Cabellos et al., 2021) show that the scarce VG use as integrated resources in teacher training means that future teachers have less favorable positions regarding their use to promote learning.

This fact takes on greater importance at present. Although the data was collected before the pandemic, it already showed the need for training in this regard. Therefore, today, after having evidenced the benefits and the need for such resources in our lives, we must favor more than ever their use in school in a pedagogical way to favor ICT uses oriented toward self-regulation and student-centered uses (Ertmer et al., 2015; Pozo et al., 2021).

5.1. Limitations and future studies

Regarding this last argument, we did not analyze the type I Barriers, so we cannot inquire about the influence of both types of barriers within the framework of the curriculum. On the other hand, some results, such as the effect of gender or teaching experience would deserve research that analyzes this construct in-depth instead of simply considering it as a variable.

We neither consider the role of *teachers' beliefs* in the teaching learning process as modulators of their *beliefs* about the effectiveness of VG. However, the use or nonuse of VG in the classroom may be also mediated by *teachers' beliefs* about how learning is best promoted (Fives and Gill, 2015; Pérez Echeverría et al., 2022; Pozo et al., 2006). Alqurashi and Williams (2019) found that these *conceptions* predicted the positions taken by teachers regarding the educational use of VG. Similar results have been found about the use of ICT and different teacher profiles (Tondeur et al., 2008). In future studies, it would be of interest to probe into this relationship between teachers' teaching *learning conceptions* and the educational use of VG.

Another limitation of our study is that we focused only on *beliefs* and did not analyze their relationship with educational practice, i.e., the actual uses that teachers make of VG in their classrooms. Future studies should also delve into these relationships between *conceptions* and teaching practices, which cannot be understood linearly but are processes of mutual interaction (Clarà and Mauri, 2010; Ertmer et al., 2015).

We do however consider it interesting for future research to study the connection between *self-perceived competence* and its relationship with *conceptions*. For example, in ICT research, Sang et al. (2010) point out the importance not only of the *conceptions of learning* or the *attitude of teachers* towards technologies but also the importance of *self-perceived efficacy* that can only be achieved from solid training in the use of them. However, no studies have investigated this relation with VG yet.

Another problem was the data interpretation of this study because the questionnaire asked about the educational potential of VG in general. However, there is a great diversity of VG that have different educational uses. For example, we think the skeptical position of teachers about prosocial learning with VG could be different if we ask them specifically about VG such as *Lemmings*, *PeaceMaker,* or *Papers, please*, whose designs are intended to deal with social issues (Alhabash and Wise, 2012; Formosa et al., 2016; Greitemeyer et al., 2010). This undifferentiated treatment in the questionnaire may have masked the diversity of *teachers' beliefs* about the use of specific VG in the classroom. Future studies should link these *beliefs* to different VG to better understand the educational potential that teachers attribute to prosocial VG.

Finally, we also consider that although the use of a questionnaire allows to identify specific aspects of *teachers' beliefs* about learning through VG, it would be necessary to complement these results with qualitative studies that help us to get a deeper knowledge about the *teachers' conceptions* about VG for learning.

Declarations

Author contribution statement

Juan-Ignacio Pozo, Phd; Beatriz Cabellos, PhD student & Daniel L. Sánchez: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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