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The effects of a gamified project based on historical thinking on the academic performance of primary school children

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History education research has long defended a transformation of the teaching and learning process in order to overcome the repetitive and conceptual learning of history, advocating an approach based on the development of historical thinking. Gamification is an innovative educational tool which may facilitate the learning of historical thinking concepts in the classroom. The objective of this quasi-experimental research was to verify whether the learning of history of 4th year primary school children improved following the implementation of a gamified project in the classroom compared with a control group which followed a traditional methodology. For this purpose, the learners completed a mixed performance test before and after the classroom intervention. The results showed significant differences in the intergroup (posttest) and intragroup (pretest–posttest) comparisons. This research may serve as a reference point for promoting the implementation of gamification in the primary classroom, and for orienting teacher training programmes towards an epistemological and methodological change.

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Introduction

At the present time, there is an educational trend which defends the incorporation of active methodologies in the classroom (Muntaner et al., 2020). One innovation which is progressively acquiring greater relevance in the context of education is gamification due to the benefits which it can contribute in terms of pupils' motivation, participation, involvement, interest and learning (Area and González, 2015; Lee and Hammer, 2011; Prieto, 2020).

One of the main areas of knowledge which presents educational problems relating to demotivation, disinterest and superficial learning on the part of pupils is the subject of history (Liceras, 2016; Llopis and Balaguer, 2016; Sanz et al., 2017; Van Straaten et al., 2018; Zhao and Hoge, 2005). Furthermore, history education research has, for many decades, defended a change in the way the subject is taught with the objective of developing historical thinking among learners (Domínguez, 2015; Metzger and Harris, 2018; Seixas and Morton, 2013; VanSledright, 2014).

Many countries have incorporated historical thinking into their curriculums, textbooks and teaching methodology (Domínguez, 2015). However, this is not the case of Spain where this philosophy is practically absent from the curriculum, textbooks and the classroom (Gómez, Solé et al., 2020; Martínez-Hita, 2019; Martínez-Hita and Gómez, 2016, 2018).

Gamification can be a tool to contribute towards solving these problems and enabling the transformation of the teaching and learning process of history, thereby achieving an improvement in pupils' learning (Area and González, 2015; De Freitas, 2018; Goethe, 2019; Ortiz-Colón et al., 2018; Prieto, 2020). However, prior research carried out on the effects of gamification has normally focused on secondary and higher education (Gómez-Carrasco et al., 2020; Kocakoyun and Ozdamli, 2018; Lozada-Ávila and Betancur-Gómez, 2017; Prieto, 2020; Torres-Toukoumidis et al., 2018; Zatarain, 2018), with few studies being carried out in the area of primary education and the relationship between gamification and historical thinking.

Bearing this research deficiency in mind, the aim of this quasi-experimental study is to analyse the academic performance of primary education pupils in Spain following the implementation of a gamified intervention programme in the classroom based on historical thinking in order to compare it with a control group following a traditional methodology based on the use of the textbook as the main resource.

Gamification

Gamification is a concept which has aroused a great deal of interest and gained in popularity over recent years (Hamari et al., 2014; Kocakoyun and Ozdamli, 2018). It has been applied in a wide range of contexts and areas, such as education, marketing, health and sustainability, among others (Deterding et al., 2011; Kocakoyun and Ozdamli, 2018; Robson et al., 2015). The most widely accepted definition of the term is that which considers that "Gamification is the use of game design elements in non-game contexts" (Deterding et al., 2011, p. 10).

Focusing on the context of education, gamification consists of applying elements which normally form part of games to the educational process in order to improve pupils' learning experience, motivation, attention and involvement (Özdener, 2018; Robson et al., 2015). This definition could be simplified to state that gamification consists of introducing the dynamics and mechanics of games into the classroom (Rivero, 2017). However, the concept of gamification is commonly confused with others, such as the use of serious games in the classroom, game-based learning and learning by making games (Deterding et al., 2011; Marczewski, 2015; Nousiainen et al., 2018).

Serious games are those whose main purpose is educational or formative and not entertainment. In contrast, the main objective of games which are not considered to be serious is to have fun. Game-based learning consists of the use of games, be they traditional or digital, in the context of education in order to achieve a learning objective. On the other hand, learning by making games involves pupils understanding specific contents by designing and making a game.

However, gamification is not based on the use of games, but rather on the use of the design and elements of games, the main purposes of which are not entertainment, but to make a non-recreational experience more attractive and to increase the level of motivation and involvement of the participants (Karatas, 2014).

Elements of gamification

The game elements which make it possible to create a gamified experience can be classified into different categories according to different authors (Hunicke et al., 2004; Werbach and Hunter, 2012).

Gamification, according to the MDA framework (Hunicke et al., 2004), is built upon the following three principal elements: mechanics, dynamics and aesthetics.

Mechanics refers to the rules of the game and to the PBL (Points, Badges and Leaderboards) system. Along with other elements, such as the use of avatars, they make it possible to increase the extrinsic motivation of pupils and favour their involvement in the learning process.

The dynamics are related to the behaviour or the way in which the participants act, and the situations created when applying the mechanics. This is a more abstract aspect than the mechanics which is crystallised in missions or challenges which enable pupils to be aware of their progress thanks to the feedback received and their evolution in the achievement of a certain status or level. This leads to a sensation of individual progress and maintains the pupils' interest throughout the whole process.

Last of all, aesthetics refers to the emotional and sensorial response of the participants. It is essential, therefore, that the experience should be attractive and the use of a narrative as a central theme bringing together all of the missions or challenges is of prime importance. This narrative serves as a basis and framework for the whole learning pathway and must attract the attention of the participants. Thus, it is necessary to bear in mind the context in the gamification design.

Werbach and Hunter (2012) classified the elements of gamification into three categories: dynamics, mechanics and components.

The dynamics are the most general aspects of gamification, such as the narrative, emotions, limitations and progression. The mechanics are the basic components which stimulate participation and the development of the activity, such as the challenges, rewards, feedback, competition and cooperation. The components are the specific elements of the game, such as avatars, insignias, points, classification tables, levels, etc. Thus, in the latter element, the aforementioned PBL system is included.

Gamification in education

The application of these elements in the context of education contributes towards creating an immersive learning experience which is similar to a game; an experience in which pupils are completely immersed in the narrative of the gamification and are in a state of concentration aimed at completing the missions (Jaramillo and Castellón, 2012). This is related with the concept of flow proposed by Csikszentmihalyi, which is defined as the mental state of complete immersion in the task being carried out

in which the individual is fully involved and entertained (Teixes, 2014). Gamification, therefore, makes it possible to transform learning into an immersive experience which contributes to a greater degree of motivation, interest, commitment and, even, performance among pupils due to the fact that they find themselves in the aforementioned state of flow (Ortiz-Colón et al., 2018; Prieto, 2020).

This does not mean that classes are transformed into a game, as the specific objective of gamification is learning from a motivating point of view (Kapp, 2012). In such a way, gamification facilitates the internalisation of knowledge and the acquisition of learning in a more entertaining way, as the pupils have an interest in learning in order to overcome the challenges proposed (De Freitas, 2018; Goethe, 2019; Prieto, 2020). Furthermore, the contents will be significant for the pupils as they are emotionally involved (Barton, 2008).

However, some studies have indicated that gamification does not imply a significant improvement in learning and may even have a negative effect on pupils' motivation and performance (Domínguez et al., 2013; Hanus and Fox, 2015; Hew et al., 2016; Mekler et al., 2017).

Nevertheless, the majority of prior research carried out shows the benefits of introducing this educational innovation in the classroom, which are reflected in pupils' learning, motivation and participation, among other aspects (Area and González, 2015; Chapman and Rich, 2018; Da Rocha-Seixas et al., 2016; Hamari et al., 2014; Kocakoyun and Ozdamli, 2018; Lozada-Ávila and Betancur-Gómez, 2017; Majuri et al., 2018; Ortiz-Colón et al., 2018; Özdener, 2018; Prieto, 2020; Subhash and Cudney, 2018; Torres-Toukoumidis et al., 2018; Yildirim, 2017).

These benefits of the application of gamification in the classroom explain its growing relevance in the field of education, as it offers a solution to some of today's educational problems, such as the lack of motivation and interest among pupils in the teaching and learning process (Area and González, 2015; Lee and Hammer, 2011; Ortiz-Colón et al., 2018).

Gamification and history

One of the main areas of knowledge in which such problems are identified is in the teaching of history, due to the fact that it is frequently considered by pupils to be boring and without usefulness or interest (Liceras, 2016; Llopis and Balaguer, 2016; Sanz et al., 2017; Van Straaten et al., 2018; Zhao and Hoge, 2005).

Learners state that one of the main reasons for this negative consideration of history is the teaching approach which is applied in the classroom, showing a preference for active and participatory methodologies (Biddulph and Adey, 2002; Harris and Haydn, 2006; Harris and Reynolds, 2014).

Thus, a curricular design based on the principles of gamification could contribute towards transforming the teaching and learning process into something interesting for pupils and, at the same time, improving learning and the acquisition of skills (Area and González, 2015; Ortiz-Colón et al., 2018).

In addition, gamification becomes a means which facilitates Project-based Learning (Ortiz-Colón et al., 2018). Along with other active learning methods, such as cooperative techniques, it allows for the active participation of pupils in the construction of their own learning. This idea is defended by the constructivist theory, the principles of which are coherent with empirical research in the field of history education (Van Straaten et al., 2018).

In this way, and in line with the current educational tendency relating to the incorporation of active methodologies in the classroom (Muntaner et al., 2020), the aim is to replace the traditional method of teaching, based on the transmission of historical contents which are to be memorised, with a teaching method based on the development of historical thinking among pupils. This implies training in problem-solving, critical thinking and the capacity for analysis, which are more complex cognitive skills related with the competences (Martínez-Hita and Gómez, 2018; Sáiz, 2013, 2015), thereby reducing the prominence of memorisation and the repetition of concepts, dates and facts.

Therefore, making use of active methodologies, such as gamification, could provide a triple response. First of all, following the educational recommendations which seek integral training in pupils' competences. Secondly, increasing interest in history. And, finally, the formation of historical thinking.

Historical thinking

In accordance with the cognitive model of the learning of history and its epistemology, history education research advocates a teaching model based on the development of historical thinking among learners (Metzger and Harris, 2018; Seixas and Morton, 2013; VanSledright, 2014).

Historical thinking is the union of certain first-order concepts, such as dates, facts and concepts, with other second-order concepts, such as the handling of historical sources, perspective and the analysis of causes and consequences or changes and continuities. In short, it consists of knowledge of the research methods of history which extend beyond the mere repetitive and conceptual learning of the subject (Domínguez, 2015; Lee, 2005; Seixas and Morton, 2013; VanSledright, 2011).

This teaching approach based on historical thinking is closely related with the guidelines established by educational institutions for teaching the achievement of competences, as, in the same way as with the competences, not only the acquisition of knowledge (knowing what) is sought, analogous to first-order concepts, but also the development of complex skills and functional learning (knowing how), similar to second-order concepts (López-Facal et al., 2017; Martínez-Hita and Gómez, 2018).

The formation of historical thinking among pupils requires a methodological change which fosters the active participation of learners in the construction of their own historical knowledge. In order to achieve this, use can be made of different strategies, among which gamification stands out (Gómez et al., 2018).

In order to achieve an improvement in the teaching of history, it is also of great importance that teachers possess theoretical knowledge of the formation of historical thinking and of the most appropriate teaching methods and strategies for its development. In this regard, teacher training becomes a fundamental aspect for this improvement (Miralles, Gómez, Arias, et al., 2019; Miralles, Gómez, 2019; Rodríguez-Medina et al., 2020; Gómez, Chaparro et al., 2020).

Along with teacher training, there are other aspects which make it difficult to bring about a change in the teaching of history, leading to a continuation of traditional methodologies in which the pupil occupies a passive role, and which engender the consideration of historical knowledge as being of little use and uninteresting. Among these aspects are education legislation, in which, in the case of Spain, conceptual content is predominant (Martínez-Hita, 2019; Martínez-Hita and Gómez, 2016), and the use of the textbook as the main educational resource, transmitting the idea of history as a linear narrative which pupils must memorise, without developing more complex cognitive capacities and in which historical thinking is absent (Martínez-Hita and Gómez, 2018).

However, in the 1970s, proposals began to emerge encouraging the initiation of pupils in the historical research method. In other words, they were encouraged to learn to think historically. These proposals have been developed in different countries and in

different educational stages, particularly in English-speaking countries such as the United Kingdom, the United States and Australia (Cooper, 2012; Levstik and Barton, 2008; Monte-Sano et al., 2015; Wineburg et al., 2013). In the case of Spain, these international proposals have been incorporated into history education research, but this transfer is not so evident, as has been mentioned previously, in the curriculum, in textbooks or in the classroom (Martínez-Hita, 2019; Martínez-Hita and Gómez, 2016, 2018).

In addition, the majority of innovative experiments in the teaching of history, such as the application of gamification in general, have mainly been carried out in secondary and higher education, with primary education receiving little attention, as also occurs in the case of the joint analysis of gamification and historical thinking (Dichev and Dicheva, 2017; Dicheva et al., 2015; Gómez-Carrasco et al., 2020; Kocakoyun and Ozdamli, 2018; Lozada-Ávila and Betancur-Gómez, 2017; Prieto, 2020; Torres-Toukoumidis et al., 2018; Zatarain, 2018).

Previous studies have highlighted the need to analyse the methods and strategies of history teaching and the effects of gamification in different levels of education (Bicen and Kocakoyun, 2018; Buckley et al., 2017; Rodríguez-Medina et al., 2020). Herein lies the significance of this study, which aims to analyse the results of the implementation of a gamified intervention programme based on the approach of historical thinking and on active and inclusive methods in a 4th year primary education class in Spain, with the aim of verifying its effect on the pupils' learning.

Objectives

The main objective of this research was to analyse the learning outcomes of 4th year primary pupils following the implementation of a gamified project in the classroom for the teaching of historical thinking, comparing the results with a control group which followed a traditional methodology for the teaching of the same contents.

This general objective was defined in the following three specific objectives:

- SO1: To compare the learning outcomes of the experimental group in the posttest with those obtained in the pretest.
- SO2: To compare the learning outcomes of the control group in the posttest with those obtained in the pretest.
- SO3: To compare the learning outcomes of the control group and the experimental group in the pretest and in the posttest.

Method

Participants. This study was carried out with two groups of 4th year primary pupils in a state-run school in the Region of Murcia (Spain) during the 2017/2018 academic year. The context and socioeconomic and cultural level of the school and the families is characterised as low, with a high percentage of immigrants and pupils of gypsy ethnicity.

The selection of the groups and participants was non-probabilistic and incidental in nature, as the sample was selected in accordance with accessibility to the subjects and suitability to the objectives of the research (Bisquerra, 2014). Furthermore, the participants remained in their class groups, thus maintaining their natural groups. The experimental group was made up of 23 children, whereas the control group consisted of 21 pupils. Thus, the total number of participants in this research was 44 people ranging from 9 to 10 years of age.

Regarding the ethical issues, a informed consent was obtained from their legal guardians and the research project received the approval of the University of Murcia's Research Ethics Commission.

Research design. This research is framed within the methodology of programme evaluation and follows the CIPP model (Guba and Stufflebeam, 1970; Latorre et al., 2003), which is the acronym for four types of evaluation: context, input, process and product. The results presented in this paper correspond to the evaluation of the product, that is to say, the analysis and evaluation of the results of the application of the programme in order to determine whether its objectives were achieved.

In order to achieve this, a quasi-experimental design was followed with an experimental group and a control group and the use of a pretest and posttest.

Data collection tool. The data collection tool employed was a mixed pupil performance test elaborated ad hoc for the evaluation of the learning standards established in the educational curriculum (CARM, 2014) and programmed in the subject of social sciences for the third term of the 4th year of primary education.

The aforementioned performance test was made up of 11 items with different types of response, such as multiple choice, open response or simple response (see Table 1). The same test was used in the pretest and in the posttest. These items were evaluated using a scale of 0–4, in which each value was assigned an achievement indicator.

The tool was validated by way of the expert judgement technique according to the criteria of relevance, clarity, coherence and adequacy for each item. The analysis of its psychometric characteristics demonstrated that it possessed content validity (Escobar-Pérez and Cuervo-Martínez, 2008) with a moderate degree of agreement among the judges (Landis and Koch, 1977) (see Table 2), and an extremely high degree of internal consistency according to Bisquerra (1992) and was considered excellent according to the criteria of George and Mallery (2003), as the Cronbach's alpha coefficient obtained a value of 0.937.This indicated that the pupils' responses to the items consistently reflected the construct which was being measured, in other words, their knowledge regarding history.

Procedure. This research was carried out in accordance with the CIPP model: context, input, process and product (Guba and Stufflebeam, 1970).

First of all, prior to the implementation of the intervention programme in the classroom, the context was evaluated in order to detect necessities and to identify problems which required solutions. The analysis of the Spanish curriculum and textbooks revealed the absence of historical thinking in primary education (Martínez-Hita and Gómez, 2018; Martínez-Hita, 2019).

Subsequently, the gamified project for learning about prehistory and ancient history was designed, according to the programme of the subject of social sciences in the 4th year of primary education and in coherence with the legislation in force and its curricular elements: contents, assessment criteria and learning standards (CARM, 2014). The design of the gamified project was evaluated and validated by the method of expert judgement (Martínez-Hita and Miralles, 2020) as part of the evaluation phase of the input.

Then, during the third term of the 2017/2018 academic year, the gamified project based on active and inclusive methodologies was implemented along with a historical thinking approach in the class of the experimental group. On the other hand, the control group followed a traditional methodology based on the use of the

Table 1 Items that comprised the performance test and their respective historical concepts.

Item	Historical concept
1. What is history?	Definition of history
2. How is history written?	Construction of historical knowledge
3. Who writes history?	The historian's task
4. What is a historical source? What is it for?	Role of evidence
5. Look at the picture and write which event marked the end and the beginning of the following ages:	Chronology
(a) From Prehistory to History	
(b) From the Ancient History to the Middle Ages	
(c) From the Middle Ages to the Modern Age	
(d) From the Modern Age to the Contemporary Age	
6. Circle the pictures that belong to the Prehistoric Ages.	Evidence
7. Explain why the discovery of agriculture and livestock was so important. Describe at least one major change it brought about in people's lives.	Historical significance Continuity and change
8. Look at the map and answer the following questions:	Evidence
(a) What information does the map give?	
(b) About which historical period does it give information?	
9. The following timeline shows the different periods into which Prehistory is divided. Explain briefly how you would live in each of them: Palaeolithic, Neolithic, Metal Age.	Historical perspective
10. Imagine that now you are not living in Prehistory, but in the Ancient Ages. Explain briefly how you would live there.	Historical perspective
11. Look at the map.	Evidence
(a) About which historical period does it give information?	
(b) What information does the map give?	
(c) Compare this map with the one in question number 8, which map is about an older era?	

Table 2 Kendall's w test. coefficient of concordance.

Criteria	Kendall's *W*	*p*
Relevance	0.534	0.001
Clarity	0.556	0.000
Coherence	0.573	0.000
Adequacy	0.530	0.001

textbook for the teaching of the same contents relating to prehistory and ancient history.

The pretest was administered to the pupils of both groups before initiating the educational intervention. Upon completion of the programme, the posttest, which was the same tool as in the pretest phase, was administered in order to evaluate the pupils' learning and the intervention programme as a whole.

As far as the gamified project designed is concerned, it included different tools and game elements, such as a narrative which was the common thread in all of the proposed missions, avatars, challenges, points, badges, rewards and levels of achievement. Furthermore, the design of the gamified project was based on the historical thinking skills and on the introduction of active and inclusive methodologies, along with cooperative work (Martínez-Hita and Miralles, 2020).

Data analysis. The data were coded and analysed using the SPSS v.24 statistical programme. For the coding and scoring of the pretest and posttest responses, a 5-point scale, ranging from 0 to 4, was employed, assigning a particular achievement indicator to each value for each of the items.

Descriptive statistical analyses were carried out and nonparametric tests were applied for intergroup and intragroup comparison as the verification of the normal distribution of the statistics (Shapiro–Wilk) indicated a non-normal distribution ($p < 0.05$).

The Mann–Whitney *U* test was performed in order to make a comparison between the control group and the experimental group and, for the intragroup comparison, the Wilcoxon *W* test was employed. Statistical significance was established with a *p*-value ≤ 0.05.

The effect size was also calculated using the Rosenthal R test (Rosenthal, 1991) in order to determine the size of the differences in the intergroup and intragroup comparisons.

Results

The results are presented in accordance with the specific objectives of the research.

SO1: To compare the learning outcomes of the experimental group in the posttest with those obtained in the pretest. Table 3 shows the descriptive statistics of the experimental group relating to the 11 items making up the pretest and posttest. It can be observed that all of them obtained an extremely low score, with the exception of item number 6, in the pretest. However, in the posttest, an increase in the scores of all the items above the mean value of the evaluation scale, that is, higher than two, can be observed, given that the maximum score it was possible to obtain in each of the items was 4.

For the comparison between the pretest and the posttest in the experimental group, the Wilcoxon *W* test was performed, which showed that there were significant differences in all of the items ($p < 0.05$) (see Table 4). The learning outcomes obtained by the experimental group in the posttest were greater than those of the pretest, as seen in Table 3. These differences were statistically significant ($p < 0.05$), with a moderate effect size (ES) in all of the items, with the exception of item 6, which is less according to Cohen's (1988) criteria.

SO2: To compare the learning outcomes of the control group in the posttest with those obtained in the pretest. Table 5 shows the descriptive statistics of the control group in the pretest and posttest for each of the items. It can be seen that the scores obtained in the posttest were low, as only three of the items (numbers 3, 6 and 9) obtained a score higher than the mean value on the evaluation scale.

Table 3 Descriptive statistics of the experimental group in the pretest and posttest.

	N	Mean	Median	Mode	Standard deviation	Minimum	Maximum
Item_1_pre	23	1.13	2.00	2	0.968	0	2
Item_1_pos	23	2.83	3.00	4	1.370	0	4
Item_2_pre	23	0.96	1.00	0	0.928	0	3
Item_2_pos	23	2.87	3.00	3	1.180	0	4
Item_3_pre	23	0.83	1.00	0	0.887	0	3
Item_3_pos	23	3.91	4.00	4	0.288	3	4
Item_4_pre	23	0.39	0.00	0	0.891	0	3
Item_4_pos	23	2.00	2.00	0	1.567	0	4
Item_5_pre	23	0.13	0.00	0	0.458	0	2
Item_5_pos	23	2.13	3.00	4	1.890	0	4
Item_6_pre	23	2.65	3.00	4	1.496	0	4
Item_6_pos	23	3.43	4.00	4	1.037	0	4
Item_7_pre	23	0.65	1.00	1	0.647	0	2
Item_7_pos	23	2.65	3.00	4	1.335	0	4
Item_8_pre	23	0.17	0.00	0	0.388	0	1
Item_8_pos	23	2.91	4.00	4	1.379	0	4
Item_9_pre	23	0.78	0.00	0	1.166	0	4
Item_9_pos	23	3.30	3.00	4	0.822	1	4
Item_10_pre	23	0.04	0.00	0	0.209	0	1
Item_10_pos	23	2.57	3.00	4	1.441	0	4
Item_11_pre	23	0.52	0.00	0	0.593	0	2
Item_11_pos	23	2.61	3.00	3	1.270	0	4

Table 4 Wilcoxon[a] *W* test of the posttest/pretest of the experimental group with the corresponding effect size.

Item	Mean	Z (Sig.)	ES	Item	Mean	Z (Sig.)	ES
Item_1_pre	1.13	−3.859[b] (0.000)	0.569	Item_7_pre	0.65	−3.972[b] (0.000)	0.586
Item_1_pos	2.83			Item_7_pos	2.65		
Item_2_pre	0.96	−3.966[b] (0.000)	0.585	Item_8_pre	0.17	−4.064[b] (0.000)	0.599
Item_2_pos	2.87			Item_8_pos	2.91		
Item_3_pre	0.83	−4.255[b] (0.000)	0.627	Item_9_pre	0.78	−4.144[b] (0.000)	0.611
Item_3_pos	3.91			Item_9_pos	3.30		
Item_4_pre	0.39	−3.548[b] (0.000)	0.523	Item_10_pre	0.04	−3.962[b] (0.000)	0.584
Item_4_pos	2.00			Item_10_pos	2.57		
Item_5_pre	0.13	−3.370[b] (0.001)	0.497	Item_11_pre	0.52	−3.973[b] (0.000)	0.586
Item_5_pos	2.13			Item_11_pos	2.61		
Item_6_pre	2.65	−2.529[b] (0.011)	0.373				
Item_6_pos	3.43						

[a]Wilcoxon signed-rank test.
[b]Based on negative ranges.

The Wilcoxon *W* test demonstrated that the posttest scores of the control group improved significantly with regard to the pretest in items 3, 4, 7, 8, 9, 10 and 11 ($p < 0.05$) (see Table 6), although the effect size (ES) and the size of these differences were small (Cohen, 1988).

A significant difference can also be observed in item 5 ($p < 0.05$), although in this case it is a worsening in the results obtained in the posttest with regard to the pretest.

SO3: To compare the learning outcomes of the control group and the experimental group in the pretest and in the posttest. Before comparing the learning outcomes in the posttest between the experimental and the control group, it was necessary to verify that there were no prior differences between the two groups.

Table 7 shows that there were no statistically significant differences between the control group and the experimental group before the educational intervention in the classroom ($p > 0.05$), with the exception of item 10 in which the control group obtained higher scores.

Conversely, as can be observed in Table 8, statistically significant differences were found in almost all of the items when comparing the learning outcomes of the control group and the experimental group in the posttest ($p < 0.05$). The experimental group obtained statistically higher scores than the control group, with a mainly moderate effect size, as its values were higher than or extremely close to 0.50 (Cohen, 1988).

Discussion and conclusions

The results showed that the experimental group, following an educational intervention employing a gamified project based on historical thinking, improved its learning outcomes significantly with regard to the pretest in all of the items which made up the performance test, with a moderate effect size. Furthermore, all of the items obtained scores higher than the mean value of the evaluation scale of the responses.

On the other hand, the control group, which followed a traditional methodology, also significantly improved its learning outcomes with regard to the pretest in more than half of the items. However, these differences were mainly small in

Table 5 Descriptive statistics of the control group in the pretest and posttest.

	N	Mean	Median	Mode	Standard deviation	Minimum	Maximum
Item_1_pre	21	1.19	2.00	2	0.928	0	2
Item_1_pos	21	1.29	2.00	2	1.007	0	3
Item_2_pre	21	0.90	.00	0	1.044	0	3
Item_2_pos	21	1.33	2.00	0	1.197	0	3
Item_3_pre	21	1.14	0.00	0	1.352	0	3
Item_3_pos	21	2.48	3.00	4	1.750	0	4
Item_4_pre	21	0.24	0.00	0	0.889	0	4
Item_4_pos	21	0.86	0.00	0	1.315	0	4
Item_5_pre	21	0.38	0.00	0	0.590	0	2
Item_5_pos	21	0.19	0.00	0	0.402	0	1
Item_6_pre	21	3.10	4.00	4	1.221	0	4
Item_6_pos	21	3.05	3.00	3[a]	0.973	1	4
Item_7_pre	21	0.62	0.00	0	0.921	0	3
Item_7_pos	21	1.24	1.00	1	0.944	0	3
Item_8_pre	21	0.29	0.00	0	0.717	0	3
Item_8_pos	21	1.57	2.00	0	1.434	0	4
Item_9_pre	21	0.95	1.00	0	1.161	0	4
Item_9_pos	21	2.19	3.00	3	1.401	0	4
Item_10_pre	21	0.43	0.00	0	0.811	0	3
Item_10_pos	21	0.86	0.00	0	1.352	0	4
Item_11_pre	21	0.90	1.00	1	0.831	0	3
Item_11_pos	21	1.48	1.00	1	1.078	0	3

[a]Multiple modes exist. The smallest value is shown.

Table 6 Wilcoxon[a] *W* tests of the posttest/pretest of the control group with their respective effect sizes.

Item	Mean	Z (Sig.)	ES	Item	Mean	Z (Sig.)	ES
Item_1_pre	1.19	−0.649[b] (0.516)	0.100	Item_7_pre	0.62	−2.310[b] (0.021)	0.356
Item_1_pos	1.29			Item_7_pos	1.24		
Item_2_pre	0.90	−1.852[b] (0.064)	0.286	Item_8_pre	0.29	−3.047[b] (0.002)	0.470
Item_2_pos	1.33			Item_8_pos	1.57		
Item_3_pre	1.14	−2.954[b] (0.003)	0.456	Item_9_pre	0.95	−3.146[b] (0.002)	0.485
Item_3_pos	2.48			Item_9_pos	2.19		
Item_4_pre	0.24	−1.994[b] (0.046)	0.308	Item_10_pre	0.43	−2.008[b] (0.045)	0.309
Item_4_pos	0.86			Item_10_pos	0.86		
Item_5_pre	0.38	−2.000[c] (0.046)	0.309	Item_11_pre	0.90	−2311[b] (0.021)	0.357
Item_5_pos	0.19			Item_11_pos	1.48		
Item_6_pre	3.10	−0.042[c] (0.967)	0.007				
Item_6_pos	3.05						

[a]Wilcoxon signed-rank test.
[b]Based on negative ranges.
[c]Based on positive ranges.

accordance with Cohen (1988). In addition, in the control group, only the average of the score of three items of the posttest was higher than the mean value of the evaluation scale. That is to say, the rest reflected insufficient learning.

As far as the comparison between the experimental group and the control group is concerned, the results showed that the academic performance of the children who participated in the gamified project was significantly higher than that of the control group. All of the items obtained higher scores in the experimental group, with the differences proving to be statistically significant in practically all of them, with the exception of item 6, and with a moderate effect size in the majority of them.

These results are coherent with those presented in prior research highlighting the benefits of the introduction of gamification in the classroom on pupils' learning, among other aspects such as motivation and participation (Area and González, 2015; Chapman and Rich, 2018; Da Rocha-Seixas et al., 2016; De Freitas, 2018; Goethe, 2019; Hamari et al., 2014; Kocakoyun and Ozdamli, 2018; Lozada-Ávila and Betancur-Gómez, 2017; Majuri et al., 2018; Ortiz-Colón et al., 2018; Özdener, 2018; Prieto, 2020; Subhash and Cudney, 2018; Torres-Toukoumidis et al., 2018; Yildirim, 2017).

Thus, it has been proved that the use of new teaching methodologies and strategies, such as gamification, can become a tool for the improvement of history education compared to traditional methodologies based on conceptual and repetitive learning (Gómez et al., 2018; Rodríguez-Medina et al., 2020; VanSledright, 2014).

Furthermore, gamification makes it possible to integrate other active learning methods, such as project-based learning and cooperative techniques (Ortiz-Colón et al., 2018). This is in line with current trends in education (Muntaner et al., 2020) and the recommendations made from educational curriculums which have the aim of educating pupils integrally in terms of

Table 7 Mann-Whitney *U* test of the pretest between the control group and the experimental group.

	Group	Average range	Sum of ranges	*U* (Sig.)	*Z*
Item_1	Experimental	22.20	510.50	234.500 (0.855)	−0.183
	Control	22.83	479.50		
Item_2	Experimental	23.00	529.00	230.000 (0.772)	−0.289
	Control	21.95	461.00		
Item_3	Experimental	21.78	501.00	225.000 (0.678)	−0.415
	Control	23.29	489.00		
Item_4	Experimental	23.33	536.50	222.500 (0.454)	−0.749
	Control	21.60	453.50		
Item_5	Experimental	20.02	460.50	184.500 (0.056)	−1.908
	Control	25.21	529.50		
Item_6	Experimental	20.89	480.50	204.500 (0.343)	−0.948
	Control	24.26	509.50		
Item_7	Experimental	23.61	543.00	216.000 (0.507)	−0.663
	Control	21.29	447.00		
Item_8	Experimental	22.24	511.50	235.500 (0.833)	−0.211
	Control	22.79	478.50		
Item_9	Experimental	21.20	487.50	211.500 (0.442)	−0.769
	Control	23.93	502.50		
Item_10	Experimental	19.91	458.00	182.000 (0.028)	−2.199
	Control	25.33	532.00		
Item_11	Experimental	19.85	456.50	180.500 (0.115)	−1.578
	Control	25.40	533.50		

Table 8 Mann-Whitney *U* test of the posttest between the control group and the experimental group with their respective effect sizes.

	Group	Average range	Sum of ranges	*U* (Sig.)	*Z*	ES
Item_1	Experimental	29.20	671.50	87.500 (0.000)	−3.760	0.567
	Control	15.17	318.50			
Item_2	Experimental	29.39	676.00	83.000 (0.000)	−3.849	0.580
	Control	14.95	314.00			
Item_3	Experimental	27.89	641.50	117.500 (0.000)	−3.542	0.534
	Control	16.60	348.50			
Item_4	Experimental	26.80	616.50	142.500 (0.013)	−2.485	0.375
	Control	17.79	373.50			
Item_5	Experimental	28.02	644.50	114.500 (0.001)	−3.377	0.509
	Control	16.45	345.50			
Item_6	Experimental	25.46	585.50	173.500 (0.078)	−1.765	0.266
	Control	19.26	404.50			
Item_7	Experimental	28.54	656.50	102.500 (0.001)	−3.352	0.505
	Control	15.88	333.50			
Item_8	Experimental	27.70	637.00	122.000 (0.004)	−2.900	0.437
	Control	16.81	353.00			
Item_9	Experimental	27.67	636.50	122.500 (0.003)	−2.939	0.443
	Control	16.83	353.50			
Item_10	Experimental	28.85	663.50	95.500 (0.000)	−3.570	0.538
	Control	15.55	326.50			
Item_11	Experimental	27.85	640.50	118.500 (0.003)	−2.990	0.451
	Control	16.64	349.50			

competencies, in the development of the capacity to solve problems, being autonomous and thinking critically towards the mere memorisation and repetition of contents.

However, this is not only in line with current trends, but also with research on history education which advocates constructivist learning and a teaching approach based on historical thinking (Metzger and Harris, 2018; Seixas and Morton, 2013; VanSledright, 2014; Van Straaten et al., 2018).

Therefore, this research has proved that the implementation of a gamified project based on historical thinking in a 4th year primary education class in Spain made it possible to obtain significantly higher learning outcomes among the participants than those obtained by pupils following a more traditional methodology based on the use of the textbook. This is also coherent with the current general education recommendations and the principles defended from the field of history education research in particular.

This study may serve as a reference point in order to promote and foster the implementation of gamification in the primary classroom and active learning methods for the development of historical thinking given the positive results obtained. Furthermore, the results of this research are also relevant for guiding

teacher training programmes towards an epistemological and methodological change.

However, a series of limitations have been identified, such as the size of the sample, the absence of external assessors or more assessors to enable a triangulation of the data. Therefore, it is suggested that this line of research be continued, increasing the number of participants, widening the levels of education analysed, and comparing gamification with other active learning methodologies in order to be able to corroborate the results obtained in the present study.

Data availability

The datasets generated during the current study are not publicly available because the identities of some participants are visible, undermining privacy protection, but are available from the corresponding author on reasonable request.

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References

Area M, González CS (2015) De la enseñanza con libros de texto al aprendizaje en espacios online gamificados. Educatio Siglo XXI33(3):15–38. https://doi.org/10.6018/j/240791

Barton KC (2008) Research on students' ideas about history. In: Levstik LS, Tyson CA (eds.) Handbook of research in social studies education. Routledge, New York, pp. 239–258

Bicen H, Kocakoyun S (2018) Perceptions of students for gamification approach: Kahoot as a case study. Int J Emerg Technol Learn 13(2):72–93. https://doi.org/10.3991/ijet.v13i02.7467

Biddulph M, Adey K (2002) Pupil perceptions of effective teaching and subject relevance in history and geography at Key Stage 3. Res Educ 71(1):1–8. https://doi.org/10.7227/RIE.71.1

Bisquerra R (1992) Introducción a la estadística aplicada a la investigación educativa. PPU, Barcelona

Bisquerra R (coord) (2014) Metodología de la investigación educativa, 4th edn. La Muralla, Madrid,

Buckley P, Doyle E, Doyle S (2017) Game On! Students' perceptions of gamified learning. Educ Technol Soc 20(3):1–10

Chapman JR, Rich PJ(2018) Does educational gamification improve students' motivation? If so, which game elements work best? J Educ Bus 93(7):315–322. https://doi.org/10.1080/08832323.2018.1490687

Cohen J (1988) Statistical power analysis for the behavioral sciences, 2nd edn. Lawrence Erlbaum Associates, New Jersey

Comunidad Autónoma de la Región de Murcia (CARM) (2014) Decreto 198/2014, de 5 de septiembre, por el que se establece el currículo de la Educación Primaria en la Comunidad Autónoma de la Región de Murcia. Bol Of Reg Murcia 206:33106–33137

Cooper H (2012) History 5–11. A guide for teachers. Routledge, London

Da Rocha-Seixas L, Gomes AS, De Melo-Filho IJ (2016) Effectiveness of gamification in the engagement of students. Comput Hum Behav 58:48–63. https://doi.org/10.1016/j.chb.2015.11.021

De Freitas S (2018) Are games effective learning tools? A review of educational games. J Educ Technol Soc 21(2):74–84

Deterding S, Dixon D, Khaled R, Nacke L (2011) From game design elements to gamefulness: defining "gamification". In: Lugmayr A (ed) Proceedings of the 15th international academic MindTrek conference: envisioning future media environments. ACM, New York, pp. 9–15. https://doi.org/10.1145/2181037.2181040

Dichev C, Dicheva D (2017) Gamifying education: what is known, what is believed and what remains uncertain: a critical review. Int J Educ Technol High Educ 14(9):1–36. https://doi.org/10.1186/s41239-017-0042-5

Dicheva D, Dichev C, Agre G, Angelova G (2015) Gamification in education: a systematic mapping study. Educ Technol Soc 18(3):75–88

Domínguez A, Saenz-de-Navarrete J, de-Marcos L, Fernández-Sanz L, Pagés C, Martínez-Herráiz JJ (2013) Gamifying learning experiences: practical implications and outcomes. Comput Educ 63:380–392. https://doi.org/10.1016/j.compedu.2012.12.020

Domínguez J (2015) Pensamiento histórico y evaluación de competencias. Graó, Barcelona

Escobar-Pérez J, Cuervo-Martínez Á (2008) Validez de contenido y juicio de expertos: una aproximación a su utilización. Av Medición 6:27–36

George D, Mallery P (2003) SPSS for windows step by step: a simple guide and reference. 11.0 update, 4th edn. Allyn & Bacon, Boston

Goethe O (2019) Immersion in Games and Gamification. In: Goethe O (ed) Gamification Mindset. Human–Computer Interaction Series, Springer, Cham, pp 107–117. https://doi.org/10.1007/978-3-030-11078-9_10

Gómez CJ, Chaparro A, Felices MM, Cózar R (2020) Estrategias metodológicas y uso de recursos digitales para la enseñanza de la historia. Análisis de recuerdos y opiniones del profesorado en formación inicial. Aula Abierta 49 (1):65–74. https://doi.org/10.17811/rifie.49.1.2020.65-74

Gómez CJ, Ortuño J, Miralles P (2018) Enseñar ciencias sociales con métodos activos de aprendizaje. Reflexiones y propuestas a través de la indagación. Octaedro, Barcelona

Gómez CJ, Solé G, Miralles P, Sánchez R (2020) Analysis of cognitive skills in history textbook (Spain–England–Portugal). Front Psychol 11:521115. https://doi.org/10.3389/fpsyg.2020.521115

Gómez-Carrasco CJ, Monteagudo-Fernández J, Moreno-Vera JR, Sainz-Gómez M (2020) Evaluation of a gamification and flipped-classroom program used in teacher training: perception of learning and outcome. PLoS ONE 15(7):1–19. https://doi.org/10.1371/journal.pone.0236083

Guba EG, Stufflebeam DL (1970) Evaluation: the process of stimulation, aiding, and abetting insightful action. Indiana University, Indiana

Hamari J, Koivisto J, Sarsa H (2014) Does Gamification Work?– A Literature Review of Empirical Studies on Gamification. In: Sprague RH (ed) 2014 47th Hawaii International Conference on System Science (HICSS), IEEE Computer Society, NW Washington, DC, pp 3025–3034. https://doi.org/10.1109/HICSS.2014.377

Hanus MD, Fox J (2015) Assessing the effects of gamification in the classroom: a longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. Comput Educ 80:152–161. https://doi.org/10.1016/j.compedu.2014.08.019

Harris R, Haydn T (2006) Pupils' enjoyment of history: what lessons can teachers learn from their pupils? Curric J 17(4):315–333. https://doi.org/10.1080/09585170601072544

Harris R, Reynolds R (2014) The history curriculum and its personal connection to students from minority ethnic backgrounds. J Curric Stud 46(4):464–486. https://doi.org/10.1080/00220272.2014.881925

Hew KF, Huang B, Chu KWS, Chiu DKW (2016) Engaging Asian students through game mechanics: findings from two experiment studies. Comput Educ 92-93:221–236. https://doi.org/10.1016/j.compedu.2015.10.010

Hunicke R, Leblanc M, Zubek R (2004) MDA: A formal approach to game design and game research. In: Fu D, Henke S, Orkin J (eds) Proceedings of the AAAI-04 Workshop on Challenges in Game AI, AAAI Press, California, pp 1–5

Jaramillo O, Castellón L (2012) Educación y videojuegos. Chasqui. Rev Latinoam Comun 117:11–19. https://doi.org/10.16921/chasqui.v0i117.201

Kapp KM (2012) The gamification of learning and instruction: game-based methods and strategies for training and education. John Wiley & Sons, San Francisco

Karatas E (2014) Gamification in education: research trends. J Kırsehir Edu Fac 15 (2):315–333

Kocakoyun S, Ozdamli F (2018) A review of research on gamification approach in education. In: Morese R (ed) Socialization. A multidimensional perspective. IntechOpen, London, pp. 51–73

Landis J, Koch G (1977) The measurement of observer agreement for categorical data. Biometrics 33(1):159–174. https://doi.org/10.2307/2529310

Latorre A, del Rincón D, Arnal J (2003) Investigación evaluativa. In: Latorre A, del Rincón D, Arnal J eds Bases metodológicas de la investigación educativa. Ediciones Experiencia, Barcelona, pp. 243–272

Lee J, Hammer J (2011) Gamification in education: what, how, why bother? Acad Exchange Q 15(2):146–151

Lee P (2005) Putting principles into practice: understanding history. In: Donovan MS, Bransford JD (eds) How students learn: history in the classroom. National Academies Press, Washington, pp. 29–78

Levstik L, Barton K (2008) Doing history: Investigating with children in elementary and middle schools. Lawrence Erlbaum Associates, Mahwah

Liceras A (2016) Las dificultades en la enseñanza y el aprendizaje de las ciencias sociales. In: Liceras A, Romero G (coords) Didáctica de las Ciencias Sociales. Fundamentos, contextos y propuestas. Pirámide, Madrid, pp. 95–118

Llopis MA, Balaguer P (2016) El uso del juego en educación. Gamificación. In: Chiva O, Martí M (coords) Métodos pedagógicos activos y globalizadores. Graó, Barcelona, pp. 85–101

López-Facal R, Miralles P, Prats J, Gómez CJ (2017) Educación histórica y desarrollo de competencias. Graó, Barcelona

Lozada-Ávila C, Betancur-Gómez S (2017) La gamificación en la educación superior: una revisión sistemática. Rev Ing Univ Medellín 16(31):97–124. https://doi.org/10.22395/rium.v16n31a5

Majuri J, Koivisto J, Hamari J (2018) Gamification of education and learning: A review of empirical literature. In: Koivisto J, Hamari J (ed) Proceedings of the

2nd International GamiFIN Conference, CEUR Workshop Proceedings, Pori, Finland, pp. 11–19
Marczewski A (2015) Even Ninja monkeys like to play: gamification, game thinking and motivational design. CreateSpace Independent Publishing Platform
Martínez-Hita M (2019) Análisis comparativo del modelo cognitivo y conceptos históricos en el currículum español e inglés. In: EIDUM (coord) IV Jornadas Doctorales Escuela Internacional de Doctorado de la Universidad de Murcia (EIDUM). Editum, Murcia, pp. 560–563
Martínez-Hita M, Gómez CJ (2016) Diferentes enfoques sobre la enseñanza de la historia y del pensamiento histórico en el currículo español y canadiense. In: Maquilón J, Gómez CJ, Alfageme MB (eds) De la investigación a la mejora educativa en las aulas. Editum, Murcia, pp. 19–32
Martínez-Hita M, Gómez CJ (2018) Nivel cognitivo y competencias de pensamiento histórico en los libros de texto de Historia de España e Inglaterra. Un estudio comparativo. Rev Educ 379:145–169. https://doi.org/10.4438/1988-592X-RE-2017-379-364
Martínez-Hita M, Miralles P (2020) Evaluación del diseño de un programa de intervención gamificado para el desarrollo del pensamiento histórico en Educación Primaria. RIFOP 34(2):187–204. https://doi.org/10.47553/rifop.v34i2.78420
Miralles P, Gómez CJ, Arias V, Fontal O (2019) Digital resources and didactic methodology in the initial training of History teachers. Comunicar 61:45–56. https://doi.org/10.3916/C61-2019-04
Miralles P, Gómez CJ, Monteagudo J (2019) Percepciones sobre el uso de recursos TIC y "mass-media" para la enseñanza de la historia. Un estudio comparativo en futuros docentes de España-Inglaterra. Educación XX1 22(2):187–211. https://doi.org/10.5944/educXX1.21377
Mekler ED, Brühlmann F, Tuch AN, Opwis K (2017) Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. Comput Hum Behav 71:525–534. https://doi.org/10.1016/j.chb.2015.08.048
Metzger SA, Harris LM (eds) (2018) The Wiley International Handbook of history teaching and learning. Wiley, Arizona
Monte-Sano C, De la Paz S, Felton M (2015) Teaching argument writing and "content" in diverse middle school history classrooms. Soc Educ 79(4):194–199
Muntaner JJ, Pinya C, Mut B (2020) El impacto de las metodologías activas en los resultados académicos. Profesorado. Rev Curríc Form Profr 24(1):96–114. https://doi.org/10.30827/profesorado.v24i1.8846
Nousiainen T, Kangas M, Rikala J, Vesisenaho M (2018) Teacher competencies in game-based pedagogy. Teach Teacher Educ 74:85–97. https://doi.org/10.1016/j.tate.2018.04.012
Ortiz-Colón AM, Jordán J, Agredal M (2018) Gamificación en educación: una panorámica sobre el estado de la cuestión. Educ Pesquisa 44:1–17. https://doi.org/10.1590/S1678-4634201844173773
Özdener N (2018) Gamification for enhancing Web 2.0 based educational activities: the case of pre-service grade school teachers using educational Wiki pages. Telemat Inform 35:564–578. https://doi.org/10.1016/j.tele.2017.04.003
Prieto JM (2020) Una revisión sistemática sobre gamificación, motivación y aprendizaje en universitarios. Teor Educ Rev Interuniv 32(1):73–99. https://doi.org/10.14201/teri.20625
Rivero P (2017) Proceso de gamificación en el aula de ciencias sociales. Íber. Didáctica de las Ciencias Sociales. Geogr Hist 86:4–6
Robson K, Plangger K, Kietzmann JH, Mccarthy I, Pitt L (2015) Is it all a game? Understanding the principles of gamification. Bus Horizons 58:411–420. https://doi.org/10.1016/j.bushor.2015.03.006
Rodríguez-Medina J, Gómez-Carrasco CJ, Miralles-Martínez P, Aznar-Díaz I (2020) An evaluation of an intervention programme in teacher training for geography and history: a reliability and validity analysis. Sustainability 12 (8):3124. https://doi.org/10.3390/su12083124
Rosenthal R (1991) Meta-analytic procedures for social research, 2nd edn. Sage, Newbury Park
Sáiz J (2013) Alfabetización histórica y competencias básicas en libros de texto de historia y en aprendizajes de estudiantes. Didáct Cienc Exp Soc 27:43–66. https://doi.org/10.7203/dces.27.2648
Sáiz J (2015) Educación histórica y narrativa nacional. Dissertation, University of Valencia
Sanz P, Molero JM, Rodríguez D (eds) (2017) La historia en el aula. Innovación docente y enseñanza de la historia en la educación secundaria. Lérida, Milenio
Seixas P, Morton T (2013) The big six historical thinking concepts. Nelson Education Ltd, Toronto
Subhash S, Cudney EA (2018) Gamified learning in higher education: a systematic review of the literature. Comput Hum Behav 87:192–206. https://doi.org/10.1016/j.chb.2018.05.028
Teixes F (2014) Gamificación: fundamentos y aplicaciones. Editorial UOC, Barcelona
Torres-Toukoumidis Á, Romero-Rodríguez L, Pérez-Rodríguez M (2018) Ludificación y sus posibilidades en el entorno de blended learning: revisión documental. Rev Iberoam Educ Distancia 21(1):95–111. https://doi.org/10.5944/ried.21.1.18792
Van Straaten D, Wilschut A, Oostdam R (2018) Measuring students' appraisals of the relevance of history: The construction and validation of the Relevance of History Measurement Scale (RHMS). Stud Educ Eval 56:102–111. https://doi.org/10.1016/j.stueduc.2017.12.002
VanSledright BA (2011) The challenge of rethinking history education. On practice, theories, and policy. Routledge, New York
VanSledright BA (2014) Assessing historical thinking and understanding. Innovative designs for new standards. Routledge, New York
Werbach K, Hunter D (2012) For the win: how game thinking can revolutionize your business. Wharton Digital Press, Philadelphia
Wineburg S, Martin D, Monte-Sano C (2013) Reading like a historian. Teaching literacy in middle and high school history classrooms. Teachers C, New York
Yildirim I (2017) The effects of gamification-based teaching practices on student achievement and students' attitudes toward lessons. Internet High Educ 33:86–92. https://doi.org/10.1016/j.iheduc.2017.02.002
Zatarain R (2018) Reconocimiento afectivo y gamificación aplicados al aprendizaje de Lógica algorítmica y programación. Rev Electrón Investig Educativa 20 (3):115–125. https://doi.org/10.24320/redie.2018.20.3.1636
Zhao Y, Hoge JD (2005) What elementary students and teachers say about social studies. Soc Stud 96(5):216–221. https://doi.org/10.3200/TSSS.96.5.216-221

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Competing interests

The authors declare no competing interests.

Additional information

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