

## Article

# Perception versus Historical Knowledge in Baccalaureate: A Comparative Study Mediated by Augmented Reality and Historical Thinking

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**Featured Application:** An intervention programme mediated by augmented reality and historical thinking exponentially improved the perception and historical knowledge of baccalaureate students in the experimental group compared to the control group.

**Abstract:** Numerous studies have shown that a traditional model persists in the teaching of history, in which students are not allowed to think for themselves and are assigned a passive role based on the mere memorisation of information. This reality is in opposition to the technological and technical boom taking place in the current educational context and to the enhancement of innovative strategies and methodologies that mark the role that students must occupy as protagonists of their own learning. This paper aims to compare the perceptions and historical knowledge of 93 baccalaureate students (16–18 years of age) following the implementation of an intervention programme based on active learning situations mediated by augmented reality and historical thinking skills. A quasi-experimental quantitative design with a non-equivalent control group was employed to meet these objectives. The results showed higher scores in the perception and knowledge of students in the experimental group compared with those in the control group. This line of work should be continued in the future with new studies to corroborate these findings, prioritising pedagogical models based on student activity and protagonism via the use of technology and critical thinking.

**Keywords:** ICT; teaching skills; teaching methods; historical methods; history; World War



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## 1. Introduction

Augmented reality (hereinafter AR) is one of the technological resources that has undergone the most rapid growth over the last decade. The review carried out by the Akçayır brothers [1], which analysed 68 research articles from the Social Sciences Citation Index (SSCI), provides evidence of this expansion. Altinpulluk [2] has also recently examined 58 SSCI articles on AR published between 2006 and 2016, highlighting its success as an academic resource and as a means of increasing motivation among students. Furthermore, a bibliometric study of 437 publications [3], dating from between 1999 and 2018, has revealed that virtual reality, mobile learning, interactive learning environments and e-learning are among the most studied and analysed concepts in current research on AR, with Spain and Taiwan being the countries with the highest number of publications and citations in this field of study. These results are backed up by a further bibliometric review carried out by Lorenzo and Scagliarini [4], which analysed 347 articles, drawing similar conclusions. However, not all fields and topics have been studied in depth, as revealed by the study

conducted by Athanasios [5], with 47 systematic reviews being published between 2010 and 2022. It could be stated that there is still a long way to go before this technology becomes consolidated. Indeed, the use of technology must be complemented by tools that enable students to think via the inclusion of alternative methodological theories.

Along these lines, despite the fact that it emerged in 1970, the methodological notion of historical thinking has become much more widespread in recent decades and is increasingly present in schools as a means of teaching students to become active citizens who are committed to society. It is now a prominent research trend in North America, the United Kingdom and Australia [6].

Historical thinking consists of developing cognitive skills that enhance people's ability to analyse past events, processes and phenomena in their temporal and cultural context in order to gain a deeper understanding of history. This approach involves asking questions about the meaning of what is relevant about the past, the identification of patterns and trends over time, the recognition of causes and consequences, the ability to formulate informed and contextualised interpretations of the past, and critical debate.

As Retz [7] points out, historical thinking has evolved under the premise of generating historical explanations from historical sources. This framework has been adapted and perfected, adopting the ideas set out in the work of its main proponent in the 21st century, Peter Seixas [8]. In Spain, the work of the Red 14 de Investigación en Enseñanza de las Ciencias Sociales, which brings together the most prestigious research groups in the sector, has also made a decisive contribution to consolidating this trend [9–14], including systematic review studies [15] and bibliometric analyses [16].

The justification for this paper is grounded in the two above-mentioned factors (AR and historical thinking), which seem to demonstrate extremely good results as far as what students think is concerned, in accordance with the studies reviewed. However, it is less clear whether they also have an influence on students' level of knowledge. Therefore, the main purpose of this study is to compare the effect of a teaching intervention mediated by AR and historical thinking skills, carried out with two groups of baccalaureate students. To this end, the following research questions have been posed.

- How can an educational intervention programme, based on an active teaching methodology including the theory of historical thinking and the implementation of augmented reality techniques, influence the perception of high school students?
- What level of historical knowledge results from comparing the methodology with which these students are taught, although similar epistemological conceptions and contents are followed?

The results found are quite noteworthy and point to substantial differences that affect the motivation, satisfaction and learning associated with radically different methodologies of implementation.

## 2. Review of the Literature

### 2.1. Moving through Augmented Reality: A Different View of Technology

The application of AR systems in education is an unquestionable reality, with certain tools and applications providing extremely good results, such as MetAClass, Metaverse, Plickers, Roar, Devar and UniteAR, among others. This demonstrates the influence of such systems on learning, without the need for programming as an irrevocable requirement [17]. Along these lines, some educational research [18–20] has pointed towards the observation of positive effects on motivation, attention and attitude, as well as on the description, acquisition and understanding of content [21–23]. Other studies in the field of education have obtained extremely good results in different disciplines, such as physical education [24,25], history and heritage [26–28], foreign languages [29], science [30,31], mathematics [32–34] and in studies with a multidisciplinary character [35]. This demonstrates that AR provides positive results in terms of satisfaction, motivation and perceived usefulness.

Experts in the scientific field of AR do not merely justify its educational impact with studies based on the perception or opinions that users hold regarding its effectiveness

and usefulness. In fact, although aspects such as ease of use, technology adoption and learners' experiences are frequently reviewed, it is rare to find evaluation approaches based on specific learning outcomes [36]. The literature analysed in this paper presents certain approaches to this issue that show the impact of this immersive technique in the epistemological domain. There is some evidence that AR leads to higher levels of learning [37–40] or improves academic performance [30,41,42]. Other research has reported that AR improves cognitive performance outcomes in terms of concentration, selective attention and socialisation [43], memory retention [44], reading comprehension [18] and historical empathy [45]. Interesting findings have also been reported in relation to concept and task understanding, as well as learning efficiency, even through the use of AR videos [46].

It has thus been proven that there are specific research results that prove that AR applied to educational and teaching processes has an impact on numerous skills, which in turn facilitate more interactive and efficient learning situations. However, as stated by Paliokas and Theodorou [36], many more studies are needed to specifically analyse the degree of knowledge that students have, after having improved their social environments through three-dimensional media, assessing their teamwork and progressing towards the creation of standards that facilitate compatibility between educational AR applications. This involves developing training programmes that allow students to actively interact with these technologies before their learning is analysed, in combination with other methodological teaching models.

## 2.2. Thinking Historically: An Unfinished Business

The predominance of the traditional approach to teaching has long been of concern to the educational sector and makes reflecting on history a major issue in schools. Herein lies the relevance that historical thinking has acquired as its aim is to encourage students to develop (by simulating the craft of the historian) critical thinking that is contextualised, nourished by rigorous sources and perspectives, empathetic and, in short, based on good judgement [47]. As Seixas and Morton [48] point out, adolescents not only need to learn about historical facts or events, but they also need to reflect on them in order to grasp their relevance and understand how they came about, thus distinguishing between factual (first-order) and procedural or analytical (second-order) contents.

Studies related to the teaching of historical thinking, particularly those that influence the prediction of academic performance and historical thinking [49], are marking a watershed in the discipline of history. Their impact is clearly noticeable in the international arena, where knowledge is increasing of the new models, methodologies, strategies and specific guidelines that are being used and valued to teach according to the methods of the historian. The first such relevant study on educational perception after a teaching process was carried out by Gómez et al. [50], who examined 293 former students of history at secondary and baccalaureate levels between 2003 and 2012. They found that almost 80% did not participate in class discussions, more than 90% stated that the teachers gave master classes, more than 80% relied only on the textbook and 65% merely copied notes without engaging in processes of historical thinking. In another study, Bartelds et al. [51] highlight the importance of historical empathy, stating that teachers and students aged 16 and 17 value it as a skill that can be learned via teaching strategies such as inviting witnesses, visiting historical sites and holding class discussions. Similarly, research conducted by the University of Murcia [52–54] should be highlighted as it presents key results of an intervention with 473 secondary and baccalaureate students. This research implemented teaching units focused on historical thinking skills and changes in teaching approach. The results show progress in terms of methodology, motivation, satisfaction and the transfer of historical knowledge, highlighting students' ability to interpret historical documents and debate current issues, as well as their high self-perception of historical learning. Based on these findings, a methodological change in the classroom is proposed to encourage work with procedural skills in the teaching of history.

The difficulty experienced by students in acquiring competence is often related to the assessment methods employed. In secondary education, most history examinations focus on substantive concepts, thus encouraging rote learning, and do not include procedural or strategic aspects, as has been pointed out in several studies [55–57]. In fact, effective history teaching in schools requires an approach to assessment that goes beyond simple multiple-choice tests, as demonstrated in a study by Smith et al. [58]. These authors show that constructed responses more accurately reflect students' historical competence and prevent vacuous processes of memorisation. In relation to the use of sources as historical evidence, Sepúlveda [59] demonstrates the scarcity of activities or teaching proposals designed to develop adolescents' historical thinking or reflection on the contributions and innovations that such activities leave on historical learning, which represents a significant challenge in the didactic renovation of history. One possible solution to this challenge could be to integrate emotional, ethical and moral elements into certain educational processes, as suggested by Bellino and Selman [60]. Their study analysed the effects of emotions and ethical reflection on historical reasoning and history teaching, with extremely positive results in terms of argumentation and historical comprehension.

In short, it is necessary to transform the way history is taught. VanSledright [61] proposes a fundamental breakthrough in developing students' understanding and cognition of history. They should be asked what they know about significant historical characters, providing in-depth arguments [62]. Today, history teaching has no future unless students are given a voice and the learning of skills is prioritised through a change in methodology that focuses on procedural content [63,64]. This methodology has been put into practice in the present study after implementing a teaching programme mediated by historical thinking competence and developed with augmented reality techniques. Subsequently, the perception of usefulness and the historical knowledge achieved by two groups of baccalaureate students have been compared.

### 3. Materials and Methods

#### 3.1. Objectives of the Research

The general objective of this study is to compare the perceptions and historical knowledge of 93 high school students before and after the implementation of an intervention programme based on active learning situations mediated by augmented reality and historical thinking skills. This objective has been divided into three specific objectives.

1. To describe the degree of perception of student motivation and satisfaction before and after the didactic intervention.
2. To describe the students' degree of historical knowledge before and after the didactic intervention.
3. To compare the degree of perception and knowledge between the experimental group and the control group after the implementation of the programme.

#### 3.2. Design and Participants

This study employs a quantitative research method. More specifically, it has a quasi-experimental non-equivalent control group design [65,66], also called a semi-experimental non-equivalent group pretest–posttest design. In fact, it is called a semi-experimental design due to the fact that, although it is not a pure experiment, it exercises a great deal of control over most sources of invalidity and is usually more rigorous than pre-experimental designs [67]. This type of design is widely used in educational research and is mainly characterised by the existence of intact groups. In other words, the groups are not randomly created, nor are participants randomly assigned to any group [68]. What is random, however, is the choice of experimental and control groups, given that students with similar characteristics were selected. In fact, the socio-cognitive background of the participants in this research is similar (a stable family background, a medium economic level, identical cultural beliefs and similar individual learning styles).

In this approach, the researcher applies a pretest, administers the condition (treatment, non-treatment or placebo) to each group and applies a posttest. This was the case in the present study, in which a pretest and a posttest were applied to both groups. However, in the experimental group, a treatment (an innovative intervention programme) was applied, whereas the control group received no such treatment after the pretest, with a conventional history teaching unit being administered). This research was reported in advance and received a favourable verdict from the Research Ethics Committee of the University of Murcia (Spain). The SPSS statistical program (version 28) was used to perform the analyses.

Initially, a sample of 100 students was invited to participate in the study. However, seven of them had previously expressed their desire not to participate in the data collection process. Therefore, the final sample consisted of 93 Spanish students in the first year of baccalaureate education from three municipalities in the Autonomous Community of the Region of Murcia. As far as the procedure for selecting the participants is concerned, the decision was taken to employ a non-probabilistic selection by chance or convenience. Thus, the subjects were chosen according to their accessibility or suitability. Five intact classes of students were selected [67]. Two of these classes were randomly selected to form the experimental group (34 students), while the other three classes constituted the control or comparison group (59 students). Table 1 presents the distribution of participants, according to research group and gender, as per the identification data.

**Table 1.** Distribution according to group and gender.

Research Group	Gender	N <sup>1</sup>	% <sup>2</sup>
Experimental	Male	18	52.9
	Female	16	47.1
Control	Male	25	42.4
	Female	34	57.6

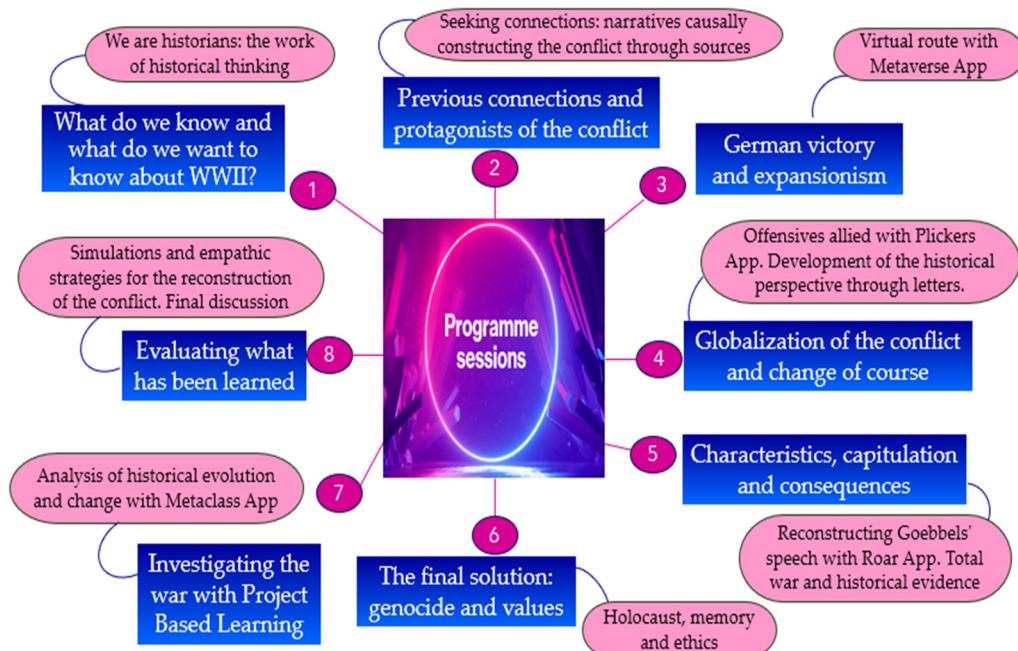
<sup>1</sup> N = Sample; <sup>2</sup> % = Percentage.

### 3.3. Teaching Process with the Two Groups

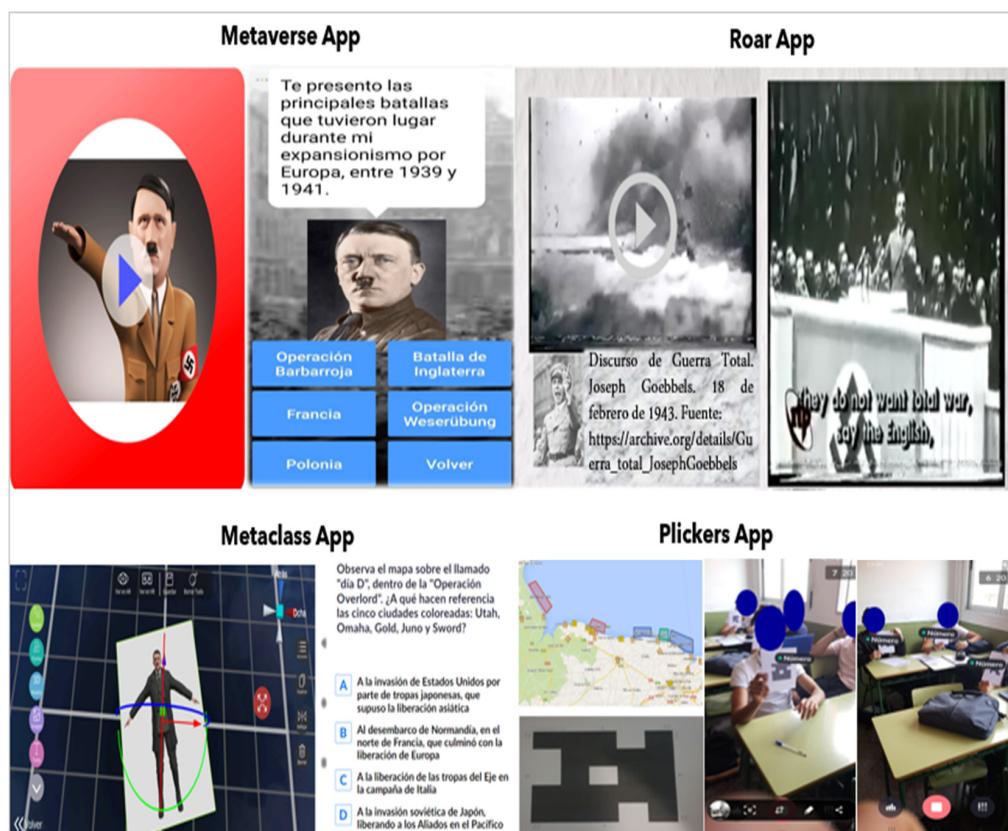
The thematic core of the intervention was the teaching of similar content about World War II (hereafter WWII) in both groups. However, very different methodologies were employed for each group. In the experimental group, an intervention programme of eight 45-minute sessions was designed and validated very positively by nine expert judges. In addition, a discussion group was held in which appropriate improvements were adopted to perfect the intervention process. The programme incorporated AR techniques and elements of content analysis based on the theory of historical thinking in each of the sessions. The content designed, although similar, required different preparatory work in the alternative teaching of the experimental group. This active approach required more complex preparation compared to the standard teaching used in the control group. This was reflected in the creation of resources, the collection of sources, the development of activities, exercises and discussions, the development of group dynamics for historical thinking and the editing of visual media and digital AR tools.

Figure 1 shows a summary of the eight sessions of the programme, showing the AR applications and the historical thinking concepts used for the thematic approach to WWII.

In order to further explore the use made of the technology, Figure 2 shows some examples of the work process and interaction with the AR applications used (Metaverse [69], Roar [70], MetAClass [71] and Plickers [72]).



**Figure 1.** Methodological highlights of the intervention programme with the experimental group.



**Figure 2.** Examples of work sessions with the augmented reality applications in the experimental group.

As identified in Figures 1 and 2, the Metaverse application was used by the students to work on creating and visualising marker contents through an interactive route in which Adolf Hitler himself tells a story in the first person with relevant information about the main victories of Nazi Germany during the period of expansionism between 1939 and 1941. Figure 2 shows how the user has the freedom to choose which stage to view through

hyperlinks that lead to a variety of narratives and resources about these phases of the military conflict. On the other hand, the Roar application was used to work with images of markers containing hyperlinks to videos showing the speech given by Joseph Goebbels in 1943 on what the concept of “total war” meant to the Nazis and the Axis powers’ capacity for resistance in a phase of German defeats and the changing course of the war. With the Plickers application, interactive questionnaires about the Allied offensive were created and visualised, with the students actively participating in the construction of knowledge. Finally, using the MetAClass application, a joint research project was created in which students worked with models of relevant historical figures (Hitler, Churchill, Stalin, De Gaulle, etc.) on the processes of change and historical evolution during WWII, highlighting the peace conferences and the creation of the United Nations (UN).

In the control group, a traditional teaching unit was implemented in which students worked on contents about WWII, although they did not actively create content or use AR or historical thinking techniques. Specifically, the use of the textbook was prioritised, along with explanations provided by the teacher, note-taking, notebook activities and the visualisation of diagrams on the blackboard. In order to clarify and compare both intervention proposals, Table 2 outlines the eight sessions carried out with each of the groups.

**Table 2.** Comparison of the work sessions with the two groups.

Sessions	Curricular Contents	Groups	Implementation
1. Initial assessment	All contents	Both	Completion of the PALUSE-EH and the ESEGMU tests (pretest). Introduction and background knowledge.
2. Origins and causes of war	Origins of the conflict and general characteristics	Exp.	Work with causal narratives to reconstruct the conflict.
		Ctrl.	Explanation of the causes of the conflict.
3. German offensives	Development of the war	Exp.	Virtual AR tour on German expansionism.
		Ctrl.	Development of German victories by reproducing the school textbook.
4. Globalisation of conflict and change of direction	Development of the war	Exp.	Interactive quizzes on Allied victories and narratives developing historical perspective.
		Ctrl.	Diagrams on the blackboard on the change of course and Allied victories.
5. Technical innovation, military tactics and capitulation	Characteristics and consequences of the war	Exp.	Characteristics through work with sources and discourse analysis.
		Ctrl.	Oral explanation and activities from the book on the characteristics of the conflict.
6. Germanisation and genocide	Anti-Semitism: The Holocaust	Exp.	Interactive worksheet and discussion on the Holocaust using original sources
		Ctrl.	Master class on the Holocaust, supported by the book.
7. Consequences	Peace plans and the UN	Exp.	Research on the peace process, the founding and consequences of the UN via a digital AR project based on the processes of change.
		Ctrl.	Teacher’s outline of the human, moral, economic and political consequences.
8. Final assessment	All contents	Both	Completion of the PALUSE-UH and the ESEGMU tests (posttest).

### 3.4. Instruments

#### 3.4.1. Perception of Secondary School Students (PALUSE)

The Perception of Secondary School Students (PALUSE) instrument is an adaptation of the questionnaire designed and validated by Rodríguez-Medina et al. [54], the title of

which is Secondary School Students' Opinion of History Classes (pretest version) and Secondary School Students' Opinion of the Implementation of the History Learning Unit (posttest version). As this instrument was adapted from the original version, it needed to be revalidated. Construct validity was calculated using the Kaiser-Meyer-Olkin (KMO) fit index, the results of which were 0.802 (pretest) and 0.885 (posttest). Having obtained these results, a principal component analysis (PCA) was performed in which nine factors with an eigenvalue greater than 1 explained 69.64% of the total variance of the pretest, while seven components did the same with 72.28% of the total variance of the posttest. The reliability index was also calculated to determine the degree of internal consistency of the instrument, the results of which were 0.896 in the pretest and 0.918 in the posttest, values that could be considered to be good and excellent, respectively, according to the thesis of George and Mallory [73].

The questionnaire was administered in two versions: the pretest (Perception of Secondary School Students on the Teaching of History, PALUSE-EH) and the posttest (Perception of Secondary School Students on the Implementation of the History Training Unit, PALUSE-UH). Both instruments contain identical questions; the only distinction is that the former evaluates students' general perception of history teaching, while the latter specifically targets the participants' perception of the intervention programme or teaching unit implemented within the experimental and control groups, respectively. As far as the design of the instruments is concerned, both include a cover page presenting the questionnaire, the purpose of the research, the instructions to be followed, a reference to the guarantees of confidentiality and a note of appreciation for participation. In its main part, focusing on the historical content, the first items of the instrument measure the independent variables, namely the nominal identification data (group, sex and age). The remaining items of the questionnaire analyse some of the dependent variables of the research, employing a Likert-type scale with five response options with the following values: 1 (strongly disagree), 2 (disagree), 3 (undecided), 4 (agree) and 5 (strongly agree).

#### 3.4.2. Evaluation of World War II (ESEGMU)

The ESEGMU instrument is a knowledge test classified as a written test. Several authors [67,74] consider that it is important to ensure content validity with a standard performance test that has been trialled before being used in research. Therefore, after the test had been designed from scratch, a pilot study was conducted with 20 university students to determine how well the dimensions matched the purpose of the test, assessing the appropriateness of the questions, addressing specific problems and controlling the time taken to complete the test. Finally, a focus group of five experts in social science and methodology and specialists in university, secondary and baccalaureate education, analysed the suitability of the test, corrected inconsistencies and defined the final instrument.

This knowledge test also contains a pretest and a posttest. The items in both tests are identical, as the aim is to observe the participants' prior knowledge and the learning achieved following the implementation of the thematic unit on WWII in both the experimental and control groups. With regard to its design, the first page presents the test, the purpose of the research, the instructions to be followed by the participants, makes reference to the confidential nature of the data and thanks the students for their participation. The main body of the instrument contains some initial items referring to nominal or identification data. The remainder of the test analyses the participants' historical knowledge of WWII. To this end, the instrument is divided into three parts or dimensions: items and short answers, visual thinking, and narrative.

## 4. Results

### 4.1. Objective 1

In order to respond to research objective 1, concerning the description of the degree of perception of student motivation and satisfaction, the indices of central tendency were calculated for each of the blocks. This was done before and after the intervention, which, as

stated above, consisted of the implementation of an alternative intervention programme with the experimental group and a traditional teaching unit with the control group. Table 3 shows the descriptive results in terms of median, mean and standard deviation for each group, regarding their degree of perception of motivation before and after the thematic unit on WWII.

**Table 3.** Perception of motivation before and after the intervention.

<b>Block I. Motivation with Teaching and Learning</b>						
Items	Inst.	Groups	Md	M	Sd	
1. Motivation to learn more about history	Pretest	Exp.	3	3.26	1.163	
		Ctrl.	3	3.15	1.157	
	Posttest	Exp.	4	4.18	0.758	
		Ctrl.	3	3.19	1.224	
2. Motivation to learn and try harder	Pretest	Exp.	3	2.97	1.141	
		Ctrl.	3	3.05	1.105	
	Posttest	Exp.	4	4.18	0.758	
		Ctrl.	3	3.19	1.252	
3. Motivation to better understand the socio-cultural reality	Pretest	Exp.	3	3.23	1.130	
		Ctrl.	4	3.56	1.022	
	Posttest	Exp.	4	4.09	0.668	
		Ctrl.	4	3.46	1.164	
4. Motivation to get better grades.	Pretest	Exp.	4	3.50	1.261	
		Ctrl.	4	3.42	1.133	
	Posttest	Exp.	4	4.06	0.788	
		Ctrl.	4	3.42	1.262	
5. Motivation to be able to contribute my point of view or my own knowledge	Pretest	Exp.	3	3.26	1.136	
		Ctrl.	3	3.07	1.127	
	Posttest	Exp.	4	3.70	0.938	
		Ctrl.	3	3.08	1.193	
6. Motivation for the use of varied resources	Pretest	Exp.	4	3.50	1.161	
		Ctrl.	4	3.32	1.195	
	Posttest	Exp.	5	4.44	0.660	
		Ctrl.	3	3.20	1.399	

Note. Inst = instrument; Md = median; M = Mean; SD = standard deviation; Exp. = experimental; Ctrl. = control.

As can be observed in Table 3, the median values with respect to the pretest range between 3 and 4 points, with the maximum score occurring in items 4 and 6 ( $Md = 4$ ) for both groups. On the other hand, item 3 is the only item with a difference in value between the groups: in the experimental group, the median is 3 points, while in the control group it is slightly higher ( $Md = 4$ ). The difference in median for this item also translates into an observable divergence in terms of the trend of the mean between the experimental group ( $M = 3.23$ ;  $SD = 1.130$ ) and the control group ( $M = 3.56$ ;  $SD = 1.022$ ), with a difference of 0.33 points.

As for the posttest, a substantial improvement can be observed in the central tendency indices of the experimental group compared to the control group, where the most outstanding median is found in item 6, with a value of 5 points. This shows that more than 50% of the students in the experimental group clearly stated that they felt motivated thanks to the variety of resources used in class, while in the rest of the items of the construct the median is 4 points out of 5, placing more than half of the group between these two values. Furthermore, the mean of this block follows a trend that ranges between 3.70 ( $SD = 0.938$ ) and 4.44 ( $SD = 0.660$ ). In contrast, the scores of the control group are lower. These findings are confirmed when analysing the median, which is 4 for item 3 and item 4, but 3 for the rest of the items in the block. This indicates that more than half of the young people in the control group were between indecision and limited agreement, with their perception being widely distributed over the five response options. The mean trend follows a similar

pattern, with values ranging from 3.08 ( $SD = 1.193$ ) for item 5 to 3.46 ( $SD = 1.164$ ) for item 3, with minimal differences between all the items.

Table 4 shows the descriptive results for each group, analysing their perception of satisfaction before and after the WWII intervention.

**Table 4.** Perception of satisfaction before and after the intervention.

Block II. Satisfaction with Teaching and Learning					
Items	Inst.	Groups	Md	M	SD
7. Satisfaction with my role as a student	Pretest	Exp.	4	3.70	1.115
		Ctrl.	4	3.68	1.105
	Posttest	Exp.	5	4.38	0.779
		Ctrl.	4	3.76	0.916
8. Satisfaction with the work environment in the classroom	Pretest	Exp.	4	3.85	0.989
		Ctrl.	4	3.63	1.128
	Posttest	Exp.	4	4.03	0.870
		Ctrl.	4	3.63	0.908
9. Satisfaction with group work	Pretest	Exp.	4	3.56	1.106
		Ctrl.	3.5	3.29	1.108
	Posttest	Exp.	4	3.85	1.048
		Ctrl.	3	3.29	1.204
10. Satisfaction with my learning	Pretest	Exp.	4	3.82	0.834
		Ctrl.	4	3.71	1.130
	Posttest	Exp.	5	4.35	0.884
		Ctrl.	4	3.59	1.219
11. Satisfaction with the way topics are taught	Pretest	Exp.	4	3.97	1.087
		Ctrl.	4	4.02	0.991
	Posttest	Exp.	5	4.47	0.615
		Ctrl.	4	3.69	1.263

Note. Inst = instrument; Md = median; M = mean; SD = standard deviation; Exp. = experimental; Ctrl. = control.

As can be observed in Table 4, the median pretest values are 4 points for all of the items, with the exception of item 9, which refers to satisfaction with group work among classmates, with a median of 3.5 points for the control group. This indicates that more than half of the participants agreed or strongly agreed in relation to their satisfaction with all items except item 9 (for the control group). In fact, this was the only item with a small difference in mean value between the experimental group ( $M = 3.56$ ;  $SD = 1.106$ ) and the control group ( $M = 3.29$ ;  $SD = 1.108$ ).

However, there are notable differences between the two groups as far as the posttest is concerned. In the experimental group, the median value is 4 for items 8 and 9, and 5 for items 7, 10 and 11. Therefore, more than half of the experimental group positioned themselves between these values. Finally, the mean follows a trend ranging from 3.85 ( $SD = 1.048$ ) for item 9 to 4.47 ( $SD = 0.615$ ) for item 11, thus showing that this block was rated very highly by this group. However, the same cannot be said for the results of the control group, where slightly lower median values are observed, with a score of 4 out of 5 in all the items of the block, with the exception of item 9, which was the worst rated item, dropping to a score of 3. Thus, it can be confirmed that more than 50% of the participants in the control group were not clear about their response in reference to satisfaction with group work carried out with their peers. These differences become more visible when analysing the trend of the mean, with a range of responses between item 9 ( $M = 3.29$ ;  $SD = 1.204$ ), which was the lowest, and item 7 ( $M = 3.76$ ;  $SD = 0.916$ ), which was the highest, although it did not reach 4 points.

#### 4.2. Objective 2

Research objective 2 concerns the description of the degree of historical knowledge of the students before and after the application of the thematic unit on WWII. The ESEGMU

knowledge test was applied to both groups, at the beginning and at the end of the intervention. Once the scores for each dimension had been assigned, the parts corrected and the total score obtained, the data were categorised. For this purpose, a visual grouping of the scores was made, organising them by intervals. In this way, the results obtained could be described more clearly. The grouping or categorisation of the ratings was as follows, according to the Spanish system of examination marking, as shown in Table 5:

- Insufficient (In): 0–4.99 points.
- Sufficient (Sf): 5.00–5.99 points.
- Acceptable (Ac): 6.00–6.99 points.
- Notable (Nt): 7.00–8.99 points.
- Outstanding (Ot): 9.00–10.00 points.

**Table 5.** Level of knowledge before and after the intervention was carried out.

Inst	Groups		N	In	Sf	Ac	Nt	Ot	Md	M	SD
Pretest	Exp	Freq.	34	28	6	0	0	0	2.65	3.13	1.372
		%	100	82.4	17.6	0	0	0			
	Ctrl.	Freq.	59	55	3	1	0	0	3.40	3.20	1.372
		%	100	93.2	5.1	1.7	0	0			
Posttest	Exp.	Freq	34	9	5	5	12	3	6.58	6.44	1.779
		%	100	26.5	14.7	14.7	35.3	8.8			
	Ctrl.	Freq	59	35	17	7	0	0	4.33	4.34	1.382
		%	100	59.3	28.8	11.9	0	0			

Note. Inst = instruments; Md = median; M = mean; SD = standard deviation; Exp. = experimental; Ctrl. = control; N = sample; In = insufficient; Sf = sufficient; Ac = acceptable; Nt = notable; Ot = outstanding.

As can be observed in Table 5, before the intervention, the percentage of those participants whose knowledge was rated as insufficient is slightly higher in the control group (93.2%) than in the experimental group (82.4%), although in the former, one acceptable mark was achieved (1.7%). For this reason, a higher median score can be observed in the control group (3.40) than in the experimental group (2.65). Similarly, when calculating the mean tendency, a slight increase can also be observed in the control group ( $M = 3.20$ ;  $SD = 1.372$ ) compared to the experimental group ( $M = 3.13$ ;  $SD = 1.372$ ), which has a slightly lower value.

Once the intervention had been carried out with both groups (intervention programme with the experimental group and teaching unit with the control group), the analysis of scores in the experimental group shows that 26.5% of students obtained a grade of insufficient in the posttest version of this test, while all the rest passed, with the grade of notable being the most obtained (35.3% of cases) and 8.8% of the students achieving an outstanding grade. On the other hand, in the control group 59.3% of the students failed the test, with the rest being divided between sufficient (28.8%) and acceptable (11.9%).

These results become even more evident with the analysis of the central tendency indices. The median of the experimental group is 6.58. Thus, this mark is exceeded in more than 50% of cases, with a mean value for the group of 6.44 ( $SD = 1.779$ ). The degree of knowledge in the posttest is notably lower in the control group, with a median score of 4.33, meaning that more than 50% of the group obtained scores lower than this, with a group mean of 4.34 ( $SD = 1.382$ ).

#### 4.3. Objective 3

The third specific objective was based on comparing the degree of perception and knowledge of the experimental group in comparison with the control group following the implementation of the programme. To this end, the three variables analysed (motivation, satisfaction and knowledge) were compared by means of a comparison of grouped block means and medians, always bearing in mind that, for the specific calculation of this statistic, the values are expressed in continuous terms. The Pearson chi-squared test of independence

was then calculated. The purpose of this statistic was to assess the goodness of fit of the research results.

Table 6 shows a comparison between the groups for the three variables analysed in order to compare the degree of perception and the degree of knowledge achieved after the intervention.

**Table 6.** Comparison of grouped means and medians between the two groups.

Variables and Groups	Motivation			Satisfaction			Knowledge		
	Gr md	Gr M	SD	Gr md	Gr M	SD	Gr md	Gr M	SD
Exp.	4.13	4.14	0.519	4.26	4.22	0.631	6.58	6.44	1.780
Ctrl.	3.29	3.26	1.043	3.68	3.59	0.800	4.31	4.34	1.382

Note. Gr md = grouped median; Gr M = grouped mean; Exp. = experimental; Ctrl. = control.

As shown in Table 6, the results obtained by the experimental group are notably superior to those of the control group. This is the case in terms of perception, where the mean rating of the experimental group on the Likert scale achieves a group mean tendency of 4.14 ( $SD = 0.519$ ) out of 5 points in the motivation variable and 4.22 ( $SD = 0.631$ ) on the satisfaction variable. Furthermore, it is also the case in relation to the results on the degree of knowledge, where the experimental group obtained more than a 2-point difference on average in the final knowledge test, while the control group on average failed the test ( $M = 4.34$ ;  $SD = 1.382$ ).

These results were supported by the findings of Pearson's chi-squared test on the relationship between each of these three dependent variables and the independent variable group. To this end, the null hypothesis based on the independence between variables was taken as a starting point. After applying the test, the statistical results obtained led to the rejection of the null hypothesis and the acceptance of the alternative hypothesis for the three variables: motivation ( $\chi^2_{gl.3} = 21.02$ ;  $p = 0.000$ ); satisfaction ( $\chi^2_{gl.3} = 12.77$ ;  $p = 0.005$ ); and knowledge ( $\chi^2_{gl.4} = 32.90$ ;  $p = 0.000$ ). Thus, it can be affirmed that there is a statistically significant relationship of dependence ( $p < 0.05$ ) between the evaluation made by the experimental group and the control group in terms of motivation and satisfaction, as well as the degree of knowledge obtained, which was clearly higher in the experimental group.

## 5. Discussion

Thinking about and understanding the past in terms of its relationship with the present is a first-order precept. This research sought to overcome the outdated postulates of the traditional nationalistic teaching of the 19th century (which still persists today in many aspects) to opt for a didactic framework that can educate committed, critical citizens who actively participate in their social reality. Therefore, it has been necessary to opt for a teaching methodology in accordance with the theory of historical thinking along the lines advocated by its English-speaking proponents [8,75].

In view of the findings, there are a number of issues that require discussion. In relation to the motivation caused by the teacher's approach to teaching before the interventions with both groups, it was found that the students showed a neutral position with a balanced distribution in their answers. In fact, the highest-rated item of this construct (albeit with a barely positive score), in the calculation of both groups, states that history classes motivate students to get better marks. What is clear is that if this is the highest-rated item, it confirms the low prior motivation of students whose only reward is to improve their grades. The opportunity for students to adopt their own criteria, to learn to use resources that differ from those usually employed (textbook, notes, etc.) or to understand how the past was constructed and how it affects the present are of little relevance. These results coincide with those presented by other authors [52,53], who found that the lowest-rated item in the block is that which states that students are motivated because they can contribute their points of view and their knowledge. This evidently does not occur in traditional history classes, in which the students' role as receivers of the perspective of national identity is more

predominant than the construction of active, critical and reflective knowledge [76]. As far as the students' satisfaction with the teaching they received is concerned, the results obtained in the pretest were compared with those of other studies [52,54]. From this comparison, the present study obtains slightly higher values for this variable, since, compared to the neutral perception of these authors in their pretest, a relatively positive perception is observed here, especially in item 11, on general satisfaction with the way the teacher approaches the topics. This position, although it does not offer high values, could be due to the fact that the participants in this study have never experienced a different teaching process from the traditional method with which to compare the intervention. Thus, it would be difficult for them to be left dissatisfied.

In short, it can broadly be stated that the students' perception in the pretest (PALUSE-EH) denotes the persistence of the traditional teaching model and the almost total absence of active methods, digital resources and thinking skills, materialised in effective historical competence, which favour the transfer of learning. Monteagudo-Fernández et al. [77] obtained similar results in a study with secondary and baccalaureate students, confirming the existence of a traditional model in the teaching of history that has no room for cooperative and enquiry methodologies. This reality should point towards a teaching model that prioritises the learning of skills and student activism in the learning process. Such a position, as mentioned at the beginning of the present study, has recently been supported by several authors [63,64], who advocate a methodological change that moves away from the predominant conceptual model for the teaching of history.

Once the intervention programme (experimental group) and the traditional teaching unit (control group) had been implemented, the intervention with both groups led to an improvement in the degree of perception. In terms of motivation regarding didactic planning, the students' perception underwent significant changes. The experimental group gave a significantly higher score than the control group regarding the motivation generated by the use of a variety of resources other than the textbook (internet, audiovisual methods, historical documents, etc.). These results are similar to those of other authors [52–54], and although the degree of perception in these studies is not as high, they also highlight the fact that the most important factor is that motivation can be attributed to the use of resources other than the school textbook. This is extremely good news as far as taking steps towards methodological complementarity is concerned. In this way, the students themselves become aware that by using different kinds of resources to learn, they can and should be more motivated. In fact, it has been shown that the differences found between the two groups through the chi-squared statistic are not the result of chance, but of the methodology and the motivational factors in which each group is immersed.

On the other hand, in the subsequent analysis in both groups of their satisfaction with the planning of the intervention, most of the participants in the experimental group gave extremely favourable responses. However, this was not the case in the control group, which remained at neutral values. Two key issues stood out: the high degree of satisfaction observed in the experimental group with the way the teacher approached WWII; and the discrepancies or average satisfaction found in the control group with the group work with peers. These findings coincide with those of Gómez et al. [52,53] and Rodríguez-Medina et al. [54]. The chi-squared test of independence made it possible to complement these results in order to be able to affirm that there is a high degree of association between the responses regarding satisfaction provided by both groups. Thus, issues such as student involvement, the working atmosphere in the classroom, group tasks or the way in which the teacher approaches topics could be among the possible causes of this relationship of dependence.

It is clear that this research has raised a crucial issue for the development of intervention programmes. Active strategies and methods based on the use of AR technological applications are an excellent means to achieve learning more easily, together with the clear motivation that these techniques and methods transmit. Indeed, gamified dynamics and mobile learning have been highly evaluated in recent studies [78,79], improving motivation,

attitudes, emotional engagement and learner behaviour, as in the case of AR, which also improves satisfaction and perceived usefulness [35].

The strength of this study lies precisely in its analysis of the degree of students' historical knowledge. This made it possible to corroborate whether there were similarities or differences between what students think and what they actually learn, reaching beyond their perceptions. In the pretest, the results showed similar, rather poor, scores in both groups, with practically nine out of ten students failing the test, and the few who passed achieving the minimum passing grade (5.00–5.99 out of 10). Faced with such a situation, the question should be asked as to what is wrong with the historical education received by young people in baccalaureate and earlier stages of education. These results expand on the findings of several authors, who have also highlighted the lack of knowledge of secondary education students regarding significant historical processes of European culture [80] or armed conflicts, such as the Spanish Civil War [81].

Once the intervention programme (experimental group) and the teaching unit (control group) had been implemented, the results obtained in the experimental group improved notably in relation to the pretest and in comparison with the control group, with a difference of almost 3.5 points in the students' final grades. Therefore, these results confirm that implementing an intervention programme on history, mediated by historical thinking and complemented with AR techniques, has a positive influence on the degree of knowledge obtained. Likewise, the results of the control group (practically the same as the pretest, with a slight improvement) confirm that implementing a traditional teaching unit in which excessive use is made of the textbook and historical skills are not put into practice nor are digital media such as AR used does not offer a significant improvement in learning outcomes.

This research also contrasts with several review studies [82–84] that argue that learning mediated by mobile phones is significantly more effective than that achieved with other traditional teaching methods that do not integrate ICT into their routine. In addition, these studies claim that mobile learning also influences student participation and collaboration and their historical thinking skills. These findings support the results of the present study as a justification of the need for technological mediation through augmented reality. It seems clear, therefore, that the findings presented here can be attributed to the implementation of an alternative methodology, based on the methodological theory of historical thinking and the mediation of learning through AR technologies, as instruments that have had a significant impact on students.

Teaching 21st-century history must look to the future by shaping individuals capable of combating disinformation and problematising the past in order to value and dignify it. More ethical didactic approaches should be employed to democratise the present and educate students to be good citizens. These approaches must be carried out through the design of new intervention programmes employing the resources and methods used in this study. New approaches should also be developed to build an education model that satisfies students and, above all, has an impact on their academic performance, introducing new variables of analysis and renewed formulas for accessing information. Further research into the value of this technology in curricula across different subjects and levels of education would be of great interest, making it possible to determine whether these results can be extrapolated to other disciplinary contexts.

The present study has examined in depth the existing state of affairs. However, it is necessary to continue researching the reasons that these types of methodologies have such a positive influence on increasing student knowledge, as well as on their general perception of teaching, on their degree of motivation and satisfaction, and even on the effects of historical knowledge in other situations and contexts. Is it possible to definitively implement these methods and technological resources in the classroom? Can the trade of the historian be consolidated didactically in the classroom? The answer to these questions must be determined by future research. In the meantime, it is clear that work must continue in order to put forward arguments that will convince educational administrations that

change is possible, if what is desired is to move towards more open, efficient and democratic models of education.

## 6. Conclusions

In light of the results presented and discussed here, the contribution made by this study is key to continuing to take steps towards increasing scientific knowledge of the reality of the classroom. Specifically, it advances knowledge on the improvement of teaching methodologies, the impact that technology can have and the rise of student-led learning. Such an approach advocates the abandonment of outdated teaching methods, which do nothing to promote critical thinking or the development of civic values [85,86].

Allowing students to express their perceptions or opinions about the educational reality in which they live is essential to be able to make better future decisions based on their feelings and interests. What is more, if the historical knowledge left by the teaching methodologies they receive is analysed, along with the technological resources, strategies and guidelines employed for learning, then the findings of this study constitute an unprecedented advance.

Therefore, the main contribution of this study is providing empirical proof of the way in which students perceive their own motivation. It also shows to what degree their level of satisfaction and historical knowledge changes after their teachers have changed their teaching methodology, making use of alternative epistemological conceptions based on the theory of historical thinking and the use of AR technology. Undoubtedly, this notion of teaching goes far beyond traditional educational practices.

One possible future line of research could be to contrast the degree of historical perception and knowledge presented by students with the level of historical thinking they possess; in other words, how they are able to interpret the problems of the past and the present, how they use historical sources to provide causal explanations and how they are able to develop otherness and ethical judgements of a critical nature employing their knowledge about the past. Perhaps, analysing these three elements together, in terms of future results, could alert the scientific community to the need to change teaching routines, prioritising more active and dynamic practices.

Likewise, if AR techniques are to be definitively implemented in the classroom, it is extremely important to be precise in the design of new ways of effectively integrating AR into the activities and projects proposed by teachers, not only in the field of history teaching, but also from an interdisciplinary perspective. Moreover, the use of this technology could also be extremely useful in facilitating access to content for many students with special needs, thus favouring more inclusive and integrative environments. This debate could be another possible line of future reflection.

## 7. Limitations and Practical Socio-Educational Implications

Despite its encouraging results, this study is merely a small-scale scientific contribution, as it is a case study that cannot be generalised to the population as a whole. Furthermore, it must be reviewable and capable of supporting new evidence as it emerges. In order to bring greater rigour to the research presented, it should be mentioned here that there are some aspects that have prevented the research from being more rigorous or meeting higher standards of quality, as follows:

- We are aware of the imbalances in the sample. However, it is important to note that these are intact groups, i.e., they were not randomly created or their participants randomly assigned to any group. What was randomised was the choice of which group would receive the intervention programme. Thus, it is believed that this decision reduces potential sources of invalidity. Furthermore, the groups had similar characteristics and belonged to an identical socio-cultural context.
- It is important to emphasise that, given the small size and geographical characteristics of the participants, the results should be taken with caution and cannot be representative of the population as a whole. On the contrary, this study presents research results

obtained with a specific group of participants, from which a specific contribution to science is made. The aim was to gain a better understanding of the reality of these classes. Consequently, the research can and should be replicable and can be improved with further studies of similar characteristics that contribute to improving this field of knowledge.

The conclusions of this study are based on knowledge attained through research. The educational context demands a verification of the value and influence that this transformation in the way history is taught seems to have on learning processes. However, this process should not only encompass the way in which students perceive the teaching they receive or what historical knowledge they possess. These realities should only be the starting point to continue empirical study in the future, analysing in more depth the methodology employed and introducing new variables of analysis and alternative teaching designs that bring epistemological solidity to the practice and the field of history didactics, which is still under construction.

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