Comparative Analysis between Virtual Visits and Pedagogical Outings to Heritage Sites: An Application in the Teaching of History

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Abstract: In recent years, the teaching and learning of history have been transformed by the incorporation of active methodologies and digital tools. Virtual reality (VR) is one such tool that is being increasingly used in classrooms. It allows students to visit and experience spaces from other historical periods, even those that have been lost. However, due to its relatively slow adoption in formal educational settings, there is still a paucity of scientific references where this type of experience has been empirically tested to prove its potential benefits. Further research on this issue is therefore needed. This study presents a comparative analysis of the didactic use of historical heritage from the Roman period using two different methodological strategies: an educational visit to a museum and a virtual tour via electronic devices. The main objective is to compare the effectiveness of these two methods in terms of usability, learning outcomes, and emotional responses. The study was conducted with 51 primary school teachers in training. Data were collected using two ad hoc questionnaires, which were based on a previous one. A hybrid analysis methodology was adopted, with SPSS used for interpreting the quantitative data and Atlas Ti for the qualitative information. The results indicate that the two methodologies were perceived by future teachers as valuable resources for learning and teaching history. The emotions they evoked were primarily curiosity, joy, and motivation, with only minor occurrences of frustration, nervousness, or fear. The experience gained from this first application will make it possible to extend the study to other educational levels, to enrich the conclusions obtained and to evaluate the potential scope of using this combination of methods to develop historical competences and improve heritage education.

Keywords: heritage education; virtual reality; higher education; history teaching; technological innovation; virtual tour; museum; archaeology

1. Introduction

Many students across different educational stages perceive history as a dull subject. This is because they often associate it with memorizing dates, names, and facts in lengthy and tedious lectures [1]. Additionally, they may struggle to comprehend the explanations of events and people that seem distant and lack empathy [2,3].

In recent years, several studies conducted in the same educational field as the present study have provided enlightening results. After analyzing the experiences of high school students, it was found that 100% of them consider the subject of history boring, unmotivating, and uninspiring when the methodology is magisterial–centralist and the expository strategy predominates [4].

This is why, for at least two decades, there has been an ongoing epistemological reflection on the teaching of history. The aim is to move beyond the mere knowledge

of facts and towards the acquisition of a set of competencies that foster critical historical thinking [5]. On one hand, research in the didactics of history has generated a debate on what history should be taught and the pedagogical importance of historical knowledge [6]. On the other hand, the objective is to implement active methodologies that empower students to cease being mere receivers of information and become the protagonists of their own learning [7].

The reorientation of history teaching has coincided with the integration of technology in classrooms. Despite this process occurring over several decades, effectively incorporating technology into formal education remains a challenge for the educational system [8]. Digital tools have been used to reinforce traditional practices, sometimes prioritizing quantity over quality [9]. To make the use of technology in the classroom truly meaningful, it is essential to understand how to harness its potential and apply it to enhance the teaching–learning process of history [10]. Among the most recent technological innovations that have begun to be introduced in the field of education, virtual reality (VR) and augmented reality (AR) applications stands out due to their great potential, both didactic and motivational, as evidenced by the results of different scientific studies [11–13] that link the use of extended reality with the improvement experienced in academic performance and motivation towards learning.

In addition to the pedagogical rethinking of history, the growth of educational programs related to heritage has been contemporaneous with the development and implementation of information and communication technologies (ICTs) in the classroom [14], boosted since the beginning of this century by European educational policies. It is clear that educating individuals on the knowledge, respect, and appreciation of cultural heritage contributes to the development of critical and reflective citizenship [15,16]. Therefore, archaeological sites, popular traditions, customs and histories, historic buildings, and museum artifacts should be an integral part of the constructivist and meaningful teaching process of history [17]. The pedagogical role of historical and archaeological museums has also been enhanced and reinforced at all educational stages [18].

The successful combination of heritage education and new technologies, specifically extended reality (VR and AR), has the potential to meaningfully enhance the teaching of history. While the use of VR has seen significant growth in heritage and museum contexts, its use in formal education remains limited [19]. Examples of its usage in different educational stages can be found in Fabola & Miller [20] and Yildirim et al. [21]. In this context, the use of heritage in the teaching of history raises several questions, whether digital tools are used or not. These questions include: what impact will it have on learning content and skills in the area? How easy will it be for teachers, whether trainees or in-service, to use these methodologies appropriately? What will be the emotional impact of these methodologies? This research aims to address these questions. For this purpose, a comparative analysis will be made between two experiences with a group of trainee teachers in the subject of didactics of social sciences—didactics of history.

On the one hand, we propose a pedagogical in-person visit to museums, the institutions that play the main role in the field of heritage education. Outdoor education's didactic benefits have been internationally recognized since the end of the 19th century. Countless scientific publications report experiences in this sense at any academic stage or branch [22–24]. This is connected to the fundamental role of museum institutions in the field of education [25], which is recognized in their own code of ethics [26].

In contrast, a virtual tour of an archaeological site that is no longer accessible because it has been buried under a road after its excavation and documentation [27] is being utilized. This proposal suggests using this type of resource based on recent research on the use of extended reality applications in history education. Several studies have explored this topic, including [20,28–32], among others.

Both practices are generally motivating for students [13,33,34]. However, it is crucial to understand the emotions generated in these educational experiences to assess their impact on the teaching–learning process [35,36]. Therefore, it is essential to integrate

assessment tools that consider various aspects, including psychological, emotional, and educational factors.

This research aims to identify and compare the strengths and weaknesses of both methods of visiting heritage sites, as well as their importance for the teaching of history.

To further examine this matter, we have divided the primary objective into the following secondary objectives:

- SO1: Evaluate the potential usability and usefulness of these methodologies for teaching history in higher education.
- SO2: Analyze the learning outcomes produced by both methodologies.
- SO3: Determine the emotions experienced by students under the different methodologies.

The rest of the article is structured as follows: Section 2 presents the sample, the instrument used to collect the data, the didactic intervention implemented in this study, and the analysis of the data collected. Section 3 provides a detailed presentation of the results obtained. Finally, Section 4 offers a discussion and draws conclusions based on the analysis of the results.

2. Materials and Methods

Considering all of the above, a didactic intervention has been designed using the resources of a virtual tour and a didactic visit in order to evaluate the educational benefits of using VR for virtually visiting an archaeological site and to compare the effectiveness of both methodologies on the learning of history. This approach ensures that the benefits of both methods are maximized. The results of the intervention were collected through questionnaires and analyzed using an exploratory and descriptive–comparative methodology. A hybrid method of analysis, including both quantitative and qualitative tests, was employed. The following section outlines the parameters of this research. It is important to note that this process has been validated by the Bioethics Committee of the University of Extremadura (Ref 56/2023).

2.1. Sample

The study analyzed a sample of 51 students enrolled in the Didactics of Social Sciences—Didactics of History course, with ages ranging from 19 to 23, except for one student who was older. This research was conducted by the 3D Co-ViM research group in collaboration with the Faculty of Teacher Training at Universidad de Extremadura and the Provincial Museum of Cáceres between January and June 2023. Table 1 displays the socio-demographic characteristics of the sample.

Table 1. Socio-demographic characteristics of the sample.

Age	**19 and <23**
Gender	34 females 17 males
Access to university	46 high school 5 professional training
Mode of study pursued	22 social sciences 19 sciences 7 humanities 3 arts

2.2. Data Collection Tool

To collect data, two questionnaires were used with open- and closed-ended questions, the latter rated on a Likert scale of 1 to 5 (1 indicating complete disagreement and 5 indicating complete agreement).

The questionnaires were developed specifically for this research, adapted from a validated questionnaire that is currently in the process of being published. The questions were modified according to the experiences to be measured in this study.

The questionnaires consist of four blocks of questions:

- The first block includes socio-demographic questions.
- The second block assesses the manageability of the methodologies (1–5).
- The third block contains questions on the learning and usefulness of history (6–16).
- The fourth block is composed of questions related to emotions (17–22).
- Finally, open-ended questions are included to allow the students in the sample to express their experience.

The questionnaire has been validated by four experts, who have proposed corrections to the language, question order, wording, and structure. To analyze item reliability, Cronbach's alpha was calculated using IBM SPSS Statistics v.25 [37]. The process of obtaining the alpha involved several steps. Firstly, the initial questionnaire, which consisted of 25 items, was tested without considering the last item, an open response question. Based on the results of this initial test, two items with lower scores were removed from the questionnaire, resulting in the current version consisting of 23 items.

The durability of these data has not yet been tested in other didactic interventions, as this was the first one carried out with this tool. Future research will be able to determine the durability of these data. Table 2 displays the results for both questionnaires.

Table 2. Cronbach's alpha reliability statistics.

Questionnaire	Cronbach's Alpha	Item No	Sample
Virtual tour	0.717	22	*n* = 51
Visit to museum	0.739	22	*n* = 51

The reliability of both questionnaires is deemed acceptable as their α scores exceed $\alpha = 0.7$ [38,39]. The questionnaires used are included in Appendix A.

2.3. Description of the Didactic Intervention

The research implemented a didactic intervention in two phases, each linked to one of the tested methodologies. The aim of this research was to give the participating students the experience of learning about ancient history, especially the Roman period, through a visit to the Museum of Cáceres, where archaeological remains from this period can be found, and through a virtual tour of an archaeological site of ovens from the same period, specifically the archaeological site of "La Matilla". The computer vision experts in our multidisciplinary research group developed a virtual tool for visiting this archaeological site that is buried at present, after scanning the area and generating its digital 3D model [27].

The first part of the intervention was carried out in a practical session, where access to this virtual tour was provided so that the students could take it using their tablets or smartphones. During the tour, the students were introduced to the various elements that could be visited, as well as the graphic and textual explanatory information introduced in the virtual tour through augmented reality. Subsequently, they individually completed the questionnaire corresponding to this phase.

The second phase of the intervention involved an educational visit to the Museum of Cáceres, guided by the museum experts. The visit focused on rooms 4 and 5, which showcase the legacy of Roman civilization in our community. These rooms contain a collection of pottery that is similar to the one displayed in the "La Matilla" experience. Following the visit, the students of the sample completed the second questionnaire used in the research.

2.4. Data Analysis

The gathered information from the research instruments has been analyzed to address the objectives stated. For this purpose, a hybrid methodology was employed, combining quantitative and qualitative analysis procedures. The quantitative analysis was conducted using SPSS v.25 software. The reliability of the questionnaire was verified using Cronbach's alpha test. Descriptive statistics were analyzed for blocks two, three, and four of the questionnaires to answer SO1, SO2, and SO3, respectively.

For the qualitative analysis, Atlas Ti software (V5) was used. In this case, it was aimed at contrasting the students' emotional evaluation of the two methods tested in relation to SO2 and SO3. For this purpose, a network of categories was applied, as shown in Figure 1.
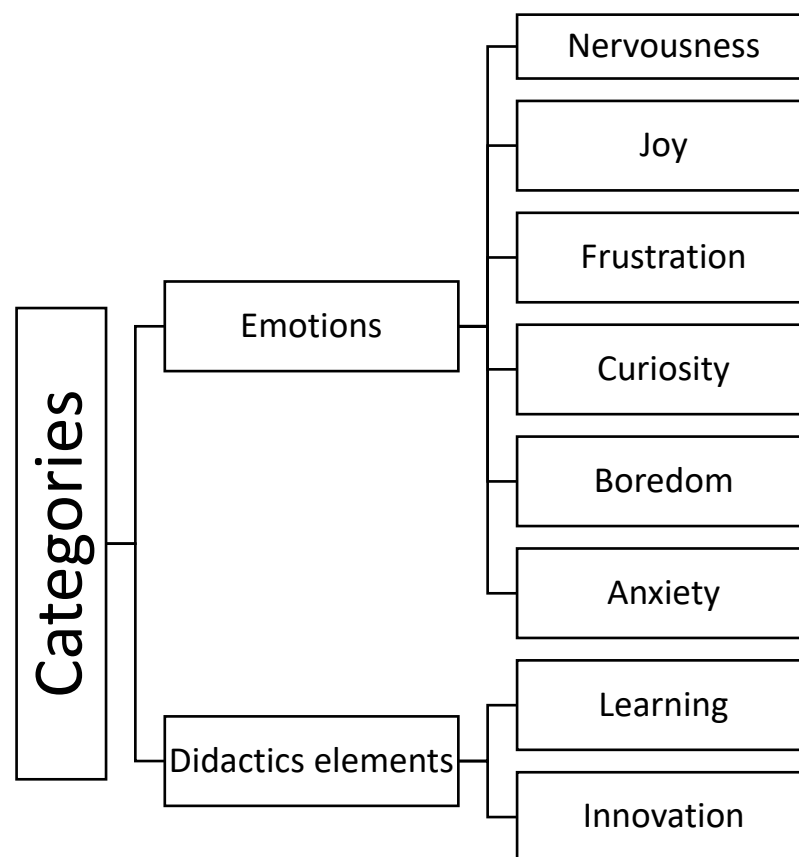
Figure 1. Network of categories for qualitative analysis in Atlas Ti.

3. Results

The tests described in the previous section have been implemented to obtain answers relevant to the research objectives established at the beginning of the study. The results are presented below in relation to these objectives.

3.1. Results of the Quantitative Analysis

Regarding SO1, we compared the information gathered from the two questionnaires to determine how well the participating students adapted to using and managing these methodologies. Table 3 provides a summary of this comparative assessment, where SD stands for "standard deviation".

It is interesting to compare items 1, 5, and 6, which relate the students' previous experience with the use of these learning methodologies to the degree of difficulty they experience in using them during the didactic intervention. Figure 2 displays a comparison of scores, with different colors indicating the score given to the item. The axis ranges from 0 to 45 and shows the number of responses obtained for each question.

Table 3. Comparison of results obtained in the second block of the questionnaire.

	Virtual Tour		Visit to Museum	
Question	**Mean Value**	**SD**	**Mean Value**	**SD**
1	3.96	0.72	4.68	0.61
2	4.26	0.71	4.19	0.79
3	2.35	1.10	3.88	1.04
4	2.03	1.04	3.11	1.01
5	2.52	1.14	2.37	1.08
6	1.63	0.92	1.49	0.95
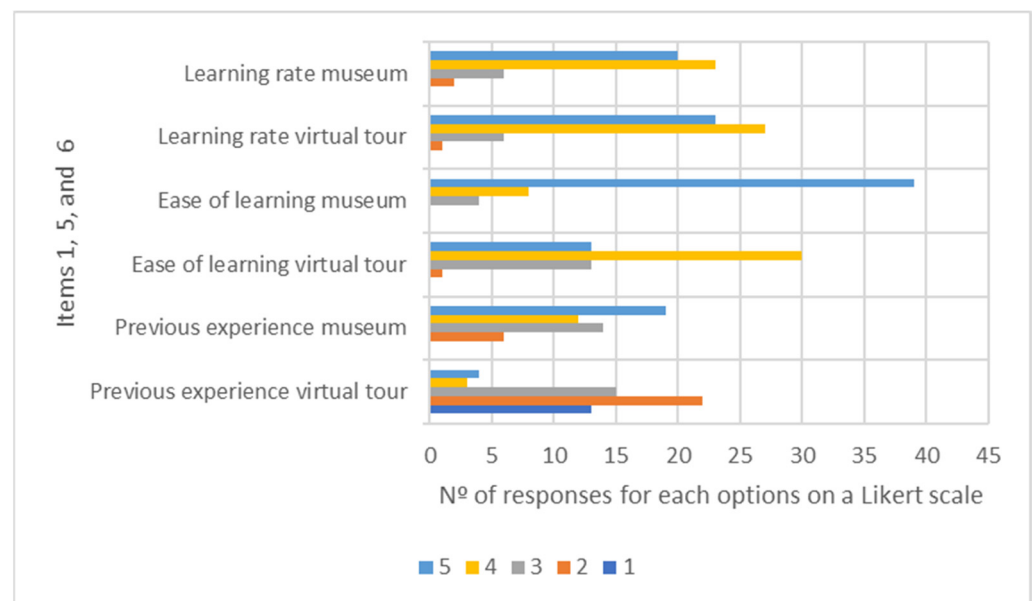
**Figure 2.** Results obtained in items 1, 5, and 6 for both methodologies (1 = low; 5 = high).

This figure reveals how the students quickly and easily adapt to the use of these methodologies (more so in the case of the museums, but also in the case of the virtual tour) and how the fact that they have not had much previous experience with the methodologies does not prevent them from adapting to them easily.

The second specific objective of this work is to compare the extent to which these methodologies favor the learning of contents and competences related to history and heritage by the students in the sample. To answer this question, block two of the questionnaires addresses a series of questions related to learning (items 7–13) and to the usefulness for the future teaching career of the participating students (items 14–17). Table 4 shows the comparison of means and standard deviations obtained for these responses in block three.

In this block, we can distinguish some interesting factors to analyze: on the one hand, we can see how both methodologies have contributed in a similar, although unequal, way to a better knowledge of various elements of the ancient historical period (items 7–9). In this aspect, both methodologies present mean values of more than 3.5 in the first of the items, and more than 4 in the second, with a slightly favorable result for the visit to museums methodology. Likewise, students rated the effectiveness of the methodologies positively in relation to their capacity for motivation and activation (item 10). On the other hand, they showed their willingness to use the tested methodologies in their future career as teachers (items 14–17), scoring these items with mean values above 4. These results can be seen in Figure 3.

Table 4. Comparison of results obtained in the third block of the questionnaire.

	Virtual Tour		Visit to Museum	
Question	**Mean Value**	**SD**	**Mean Value**	**SD**
7	3.59	0.95	3.80	0.86
8	4.59	0.67	4.82	0.63
9	4.21	0.71	4.58	0.63
10	4.70	0.52	4.41	0.82
11	3.15	1.16	4.11	0.64
12	4.29	0.85	4.25	0.81
13	3.96	0.69	4.05	0.66
14	4.15	0.65	4.66	0.61
15	4.47	0.67	4.45	0.66
16	4.45	0.56	4.39	0.68
17	4.55	0.44	4.35	0.68
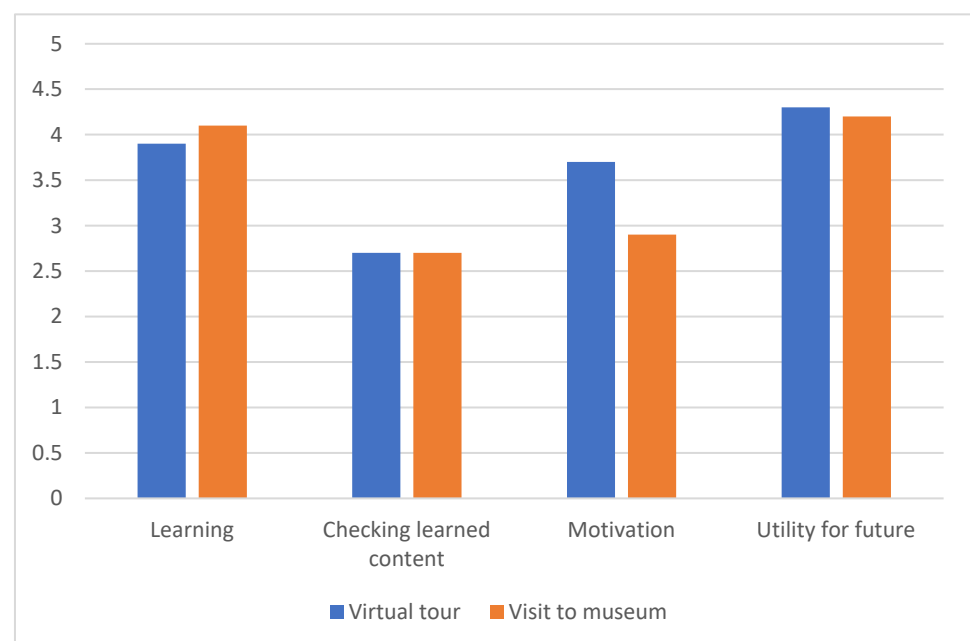
Figure 3. Results obtained in the items related to the factors analyzed (1 = low; 5 = high).

In relation to SO3, the emotions experienced by the students in the development of the didactic intervention are: curiosity, with scores above 4 in both methodologies, being more relevant in the virtual tour, and joy, with very similar values above 3.7 in both cases. The remaining emotions, considered in some studies as negative ones, obtain very low scores in general. Table 5 shows the comparative results.

Table 5. Comparison of results obtained in the fourth block of the questionnaire.

	Virtual Tour		Visit to Museum	
Emotions	**Mean Value**	**SD**	**Mean Value**	**SD**
Nervousness	1.64	0.86	1.52	0.69
Joy	3.87	0.81	3.76	0.87
Frustration	1.71	0.18	1.17	0.54
Curiosity	4.48	0.67	4.11	0.78
Boredom	1.33	0.65	1.84	0.89
Anxiety	1.12	0.49	1.11	0.42

Comparing the grouped means of the emotions that are traditionally considered positive for learning (among those analyzed, joy and curiosity would be considered in this block) on the one hand, and those that are usually considered negative for learning on the other (nervousness, frustration, boredom, and anxiety), it can be seen that in both methodologies tested, positive emotions predominate over negative ones. Figure 4 illustrates these findings.

Figure 4. Mean scores for positive and negative emotions in the two methodologies.

3.2. Results of the Qualitative Analysis

In order to analyze the responses to item 23 of the open-ended questionnaire, a qualitative analysis strategy was applied, with the categorization outlined in the methodology section (Figure 1). Based on the responses received, two factors were analyzed: emotions and didactic elements. These factors serve to contrast the information gathered in blocks three and four of the questionnaire.

In relation to the first factor, the emotion that appears most frequently is curiosity, with 36 mentions in the virtual tour questionnaire and 27 in the museum visit questionnaire. Students express their interest in exploring, discovering, and learning about the archaeological site through the virtual tour. Likewise, although less frequently in the textual sources, curiosity appears as a priority emotion in the museum visit methodology. Some examples of categorization are provided below:

"I was curious at first because I don't usually use this kind of technology, but I really enjoyed the experience because we can move around the site at will, discover objects or constructions that are no longer there, etc. I had fun and I liked the experience". Source: virtual tour (curiosity)

"What this experience has given me most is the curiosity to learn how to use this type of methodology in the classroom". Source: virtual tour (curiosity)

"It was a very good experience. The visit to the museum made me very curious, especially the archaeological part and the history behind them. The Aljibe was impressive, also thanks to the exhibition that was on display". Source: visit to museum (curiosity)

Satisfaction (16 mentions in the virtual tour questionnaire sources and 14 in the visit to museum questionnaire sources) and joy (12 mentions in the virtual tour questionnaire sources and 13 in the visit to museum questionnaire sources) follow curiosity as the most mentioned emotions. They are satisfied and feel happy and excited to find an experience

that allows them to access historical sites in a different way, as well as to have been able to visit real archaeological remains. This is visualized in the following examples:

"Satisfaction, being able to move freely and observe the space we are working with" "It has been a satisfactory experience as we have been able to observe and learn about this site through virtual reality". Source: virtual tour (satisfaction)

"Personally, the experience has given me positive feelings such as joy and enthusiasm for the fact that it is a different activity outside the classroom. Also, the fact of being able to understand history by seeing in person objects and elements that are part of it makes it much easier, apart from being a very enjoyable activity". Source: visit to museum (joy)

The qualitative emotional analysis confirms what is shown in Table 5 and Figure 4, regarding the answers given by the students of the sample to the block on emotions.

In relation to the categorized didactic elements, the motivation that the virtual tour methodology has aroused in the participants stands out (23 mentions). In the responses, the participants show a great interest and motivation to learn history through the virtual tour. The participants see this methodology as an interesting and motivating tool that can capture the attention of their future students. This encourages them to continue learning and exploring history in a more dynamic way. These results are captured from responses such as:

"It is a very interactive and motivational activity. And I find it amazing how thanks to the virtual tour we have access to places we could never access in person". Source: virtual tour (motivation)

With regard to motivation and interest, the sources of the visit to the museum questionnaire provide several examples, such as those given below:

"I found the visit interesting, so my feelings were positive, and I see it as a good way to present it as a future teacher".

"It was very interesting". Source: visit to museum (motivation)

The innovative nature of the virtual tour methodology is also mentioned extensively (17 mentions). Participants report that this methodology is innovative and dynamic for teaching history. They see its use as an alternative to traditional teaching methods, allowing them to stay more focused and entertained while learning.

"I found it a very interesting experience, it was fun. It's a dynamic way of seeing different sites without leaving the classroom." or "I think it's a different and dynamic way of learning history". Source: virtual tour (innovative character)

"I think that the visit to the museum has been very enriching, and that apart from knowing a little more about the history of the city of Cáceres, we have paid more attention to learning in a non-formal way. Besides, I had a great time with all my colleagues and the visit was entertaining". Source: visit to museum (innovative character)

The analysis of these sources confirms the high valuation made by the students of some of the learning issues, such as the motivational power and the innovative nature of the methodologies implemented.

4. Discussion and Conclusions

The main objective of this research was to analyze the strengths and weaknesses of both virtual reality implementation in heritage education and educational visits to heritage sites in history teaching and to compare the results. Questionnaires with open and closed questions were used to collect data on aspects such as learning, the usefulness of these methodologies in an educational context, and the emotions experienced by the participants. The advantages of utilizing a hybrid methodology for data collection and analysis are

well-established in the field of social sciences [40]. Qualitative data enable us to provide explanations and context to the quantitatively obtained results. For instance, ref. [21] also employed questionnaires and interviews to assess the effectiveness of virtual tours in history education. Additionally, our research includes a case study, which implies an in-depth investigation and analysis of a sample group, which does not need to be very large and enables the use of various quantitative and qualitative data collection tools, contributing to data validity through triangulation, as seen in [41].

The analysis of the results indicates that both methodologies were positively evaluated by the students, which fulfills the primary objective set in this research.

The VR methodology was highly rated, with the majority of the students giving it a top score. Concerning SO1, most participants quickly learned to use VR and did not find it complex. Additionally, they found it useful for learning history and believed it contributed to the development of digital competence, which supports the hypothesis of SO2. They also perceived that the class was more attentive and motivated with this methodology. These results align with similar studies conducted by Di Natale et al. [11] and Pellas et al. [13], which analyzed immersive virtual reality experiences with secondary and baccalaureate students. Yildirim et al. [21] also examined a VR experience for teaching history with 25 undergraduates, showing similar results to our study in terms of increased interest in the course and motivation to actively engage in learning processes. This was considered particularly beneficial for the inclusion of students with disabilities.

Visits to heritage sites received positive ratings overall, with only a small percentage of students giving lower marks. Many of the participants highly rated the experience, stating that these visits helped them gain a better understanding of historical concepts and the site itself. Moreover, the students also perceived this methodology as favoring a more comprehensive and interconnected approach to learning (SO2).

Domínguez and López [42] found that learning through heritage promotes the development of competences in future teachers, whether social, cultural, or geomorphological heritage [43]. This, in turn, leads to motivating contexts for future students and to the acquisition of a sense of identity, ultimately building committed citizenship together with the ethical responsibility that entails [44]. This is the reason why it is important to also consider at this point geoheritage education from a holistic perspective [45], since it plays a crucial role as a fundamental pillar of sustainable development, holding equal importance to the social, cultural, and economic components [46]. These findings are consistent with those of Martín et al. [15], who emphasized the importance of visiting heritage sites in nurturing critical citizenship, a point also echoed by Valencia et al. [16]. In an informal setting, the study conducted by Madariaga-Orbea et al. [25] revealed certain similarities to the present investigation. The study demonstrates that the experimental group, who participated in an intergenerational program involving museum visits and participatory meetings, exhibited heightened motivation towards history and a stronger social self-concept. However, it is essential to consider whether this intervention is suitable for meeting the unique demands and needs of everyone. Therefore, it is necessary to develop programs that consider possible interferences, such as the mediating role of the teacher.

In contrast, the study by Molina and Muñoz [47] shows that teachers do not place a high value on using heritage in education. This is due to its limited presence in textbooks and the difficulty of teaching such specific content. The analysis reveals a significant difference in the perception of heritage between experienced teachers and teachers in training. This disparity may be attributed, in part, to the difficulties that arise when using local heritage as a didactic resource. In some cases, the heritage available in the surrounding area may not align with the curriculum. This can force teachers to plan more complex outings. Similar studies further underscore the importance of utilizing heritage as a teaching resource [48–51].

Regarding the emotions experienced during both the virtual tour and the visit to the museum, a range of responses were observed. Students reported feeling low levels of

nervousness, frustration, or anxiety and high levels of curiosity and joy throughout the use of both methodologies, to answer what was raised in SO3.

Based on the studies by Dávila et al. [35], Oyarzún and Valdés-León [36], Mellado et al. [52], Borrego et al. [53], and Bravo et al. [54], it can be concluded that the study of emotions is a significant trend in recent years in the field of specific didactics.

Although the literature in the field of social sciences, specifically history and geography, is still scarce, there is already evidence of the positive emotions aroused in students using ICT in heritage education. This is based on the studies conducted by Jiménez-Palacios and Cuenca [12], which show that such initiatives improve the classroom climate and directly enhance learning outcomes among the results of this study. Likewise, when ICT is incorporated into the classroom through virtual reality experiences, the participants in our study rated it very positively, showing high acceptance and satisfaction. They positively valued their training in the management of this technology, and the learning achieved, finding it easy to use virtual reality and quickly acquiring the necessary skills to use this tool correctly. Furthermore, the participants considered this methodology to be beneficial and useful for learning history. It aided in their comprehension of concepts and facilitated long-term retention. This aligns with the findings of Menjívar et al. [34], who utilized a VR model that was highly regarded by their participants.

On the contrary, when analyzing other uses of extended reality as in the research carried out by Piqueras et al. [31], an improvement in academic performance or motivation with the use of this tool is not shown in the research performed with students in the third year of primary education. However, it does result in enhanced social integration, cooperation, and active student participation.

Another innovative approach to education using new technological tools can be found, for instance, in Egea et al. [55], who suggest using and evaluating a video game for teaching history. The results are comparable to those of the research presented in this paper, showing improved learning and student engagement due to the recreational aspect of this type of experience. Díaz et al. [56] also noted that the presence of non-player characters (NPCs) in the form of images improved the learning of contents. Additionally, Gómez-Carrasco et al. [57] analyzed the use of ICT and mass-media resources by future English and Spanish teachers, receiving a very positive evaluation.

Finally, it should be noted that the limitations of the present study include the fact that it has been applied to a small sample size of a single university center. This is because it is an exploratory study, which will serve to lay the foundations for a larger-scale study in future research. Precisely, this exploratory nature also explains why the analysis is of a comparative descriptive type, which is another limitation that will be corrected in subsequent experiences. The experience acquired in this first work of application and analysis of the combination of methodologies will allow the extension of the study to other age groups, educational stages, and qualifications, enriching the conclusions obtained and assessing the possible scope of the application of this combination of methodologies for the development of historical competences and the teaching of heritage.

Appendix A

Item Number	Section	Question	Answer
1	Usability	I find it easy to use VR	Likert 1/5
2		I learn how to use VR easily	Likert 1/5
3		I am experienced in using VR	Likert 1/5
4		I need help from those in charge to be able to carry out the activity	Likert 1/5
5		I lack the knowledge to use VR in the classroom	Likert 1/5
6		Having experience with VR makes the VR methodology more useful	Likert 1/5
7	Learning and Usefulness	I am very interested in history content	Likert 1/5
8		I think that VR can be a useful tool for learning abouthistory	Likert 1/5
9		VR makes me understand the concepts related to history better	Likert 1/5
10		I think VR makes the class be more attentive and motivated	Likert 1/5
11		After the VR experience, I have a rough idea of the dimensions of the archaeological site	Likert 1/5
12		I think that being able to rotate, observe, and move freely in the different ovens has made me pay more attention than if I were at the site	Likert 1/5
13		I think it has become clear to me where the site is located	Likert 1/5
14		I will use the VR methodology when I become a teacher.	Likert 1/5
15		Working with VR methodology in the classroom helps me to have a more transversal learning process	Likert 1/5
16		Using VR in a teaching-learning process helps to develop digital competence	Likert 1/5
17		Rate your experience with VR	Likert 1/5
18	Emotions	Nervousness	Likert 1/5
19		Joy	Likert 1/5
20		Frustration	Likert 1/5
21		Curiosity	Likert 1/5
22		Anxiety	Likert 1/5
23		Briefly explain your feelings about the experience	Open-ended

Item Number	Section	Question	Answer
1	Usability	I find it easy to use the visit to the museum	Likert 1/5
2		I learn to move around the museum easily	Likert 1/5
3		I have previous experience of visiting museums	Likert 1/5
4		I need help from those in charge to be able to carry out the visit	Likert 1/5
5		I lack the knowledge to organize a visit to a historical museum	Likert 1/5
6		Having an experience of visiting a museum makes the methodology of visiting heritage places more useful	Likert 1/5
7	Learning and Usefulness	I am very interested in history content	Likert 1/5
8		I think that visiting the museum can be a useful tool for learning about history	Likert 1/5
9		Visiting the museum makes me understand the concepts related to history better	Likert 1/5
10		I think that visiting a museum makes the class be more attentive and motivated	Likert 1/5
11		After the experience in the museum, I have a rough idea of the dimensions of the archaeological site	Likert 1/5
12		I think that being able to observe the different archaeological materials has made me pay more attention than if I were observing them in VR	Likert 1/5
13		I think it has become clear to me where these materials are located	Likert 1/5
14		I will use the methodology of visiting museums when I become a teacher.	Likert 1/5
15		Visits to heritage sites promote more transversal learning	Likert 1/5
16		Using visits to heritage sites in a teaching-learning process helps to develop digital competence	Likert 1/5
17		Rate your experience visiting the museum	Likert 1/5
18	Emotions	Nervousness	Likert 1/5
19		Joy	Likert 1/5
20		Frustration	Likert 1/5
21		Curiosity	Likert 1/5
22		Anxiety	Likert 1/5
23		Briefly explain your feelings about the experience	Open-ended

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