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How to Use Challenge-Based Learning for the Acquisition of Learning to Learn Competence in Early Childhood Preservice Teachers: A Virtual Archaeological Museum Tour in Spain

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This article presents the research results in relation to an interdisciplinary teaching innovation project—Teaching and Learning of Social Sciences and Teaching and Learning of Natural Sciences—with Early Childhood Preservice Teachers (ECPT) at the University of Alcalá (Spain) in the pandemic context by COVID-19 during 2020–2021 (N = 55): 52 women (94.55%) and 3 men (5.45%) from 20 to 22 years of age. The main research problem is to know if the ECPT improves the learning to learn competence after a challenge-based learning (CBL) linked to virtual tour in a museum. The main objective was to improve the learning to learn competence, during a virtual tour at the Community of Madrid Regional Archaeological Museum (MAR) (Alcalá de Henares, Spain) for a reflective training of students to understand problems of the past and present and future global challenges, promote collaborative and multidisciplinary work, and defend ethics and leadership. In order to ascertain the level of acquisition of this competence in those teachers who were being trained, their self-perception—pretest–posttest—of the experience was assessed through a system of categories adapted from the European Commission. ECPT worked, in small groups and using e/m-learning tools, ten challenges and one storytelling cooperatively with university teachers to solve prehistoric questions related to current situations and problems. Subsequently, two Early Childhood Education teachers from a school in Alcalá de Henares reviewed the proposals and adapted them for application in the classroom of 5-year-old boys and girls. The results show an improvement in this competence in Early Childhood Preservice Teachers: total score pre-post comparison paired-samples Wilcoxon test result shows a statistically significant difference ($p > 0.001$); an evaluation rubric verified the results of self-perception. Second, we highlight the importance of carrying out virtual museum tours from a challenge-based learning for the development of big ideas, essential questions, challenges, and activities on socioeconomic, environmental, and emotional knowledge, skills, and attitudes. Third, this

experience shows the insufficient educational adaptation of the virtual museum tour to the Early Childhood Education stage from a technological and didactic workshops point of view, but there is a diversity of paleontological and archaeological materials and a significant sociocritical discourse.

Keywords: challenge-based learning, learning to learn competence, Early Childhood Preservice Teachers, museum education, virtual tour, e/m-learning, prehistory

INTRODUCTION

Teaching can be considered as a meaningful process where knowledge is constructed, negotiated, and learned collaboratively (Adell, 2004). In relation to this, an article based on challenge-based learning is proposed under the recent global health crisis caused by COVID-19. This type of learning (hereinafter CBL) is an experience where participants develop solutions that require an interdisciplinary and creative approach for the development of competences (Olivares et al., 2018).

The CBL actively engages the student in a global and real problem situation related to the environment which implies not only the definition of a challenge but also the implementation of a solution (Johnson et al., 2009). The CBL, therefore, is constituted as a different learning opportunity through the experience and collaboration of the students to respond to a challenge of motivational involvement.

One of the most widely demanded competences today is the ability of learning to learn (Romero Ariza, 2010). International reports call for competency-based teaching, such as the Programme for International Student Assessment (PISA) report (Organisation For Economic Co-Operation and Development (OECD), 2020). We think that it is a key competence for building societal knowledge (Publications Office of the European Union, 2006) and indispensable for university students (Pérez-Pérez et al., 2020).

This interdisciplinary project has been carried out with the students of two subjects of the Bachelor's Degree in Early Childhood Education (third year; first semester) of the University of Alcalá (Spain) during the academic year 2020–2021: Teaching and Learning of Social Sciences and Teaching and Learning of Natural Sciences. Contents of the two subjects connected to a virtual tour at the Community of Madrid Regional Archaeological Museum (MAR) (Alcalá de Henares, Spain) have been considered. Finally, the challenges for 5-year-old students of the Santa María de la Providencia School (Alcalá de Henares) are elaborated.

The contribution of this study to the field of teacher training is double. First, the Early Childhood Preservice Teachers (hereinafter ECPT) conduct an innovative and educational virtual museum tour using e/m-learning tools from a CBL approach. Second, the ECPT's self-perception of their learning to learn competence was assessed at two moments of the teaching and learning process (pretest and posttest). To achieve this, our ECPT collected data and analyzed the results to solve research questions related to the teaching opportunities offered by the museum as an educational resource for children.

In short, the CBL, the work in the visit museum tour, and the acquisition of the learning to learn competence were valued, adapting to the two educational levels, ECPT and children of Early Childhood Education, although in this work we focus on university students. Regarding this, the contribution of schoolteachers and their experience is highlighted since they participated as advisers to the ECPT.

LITERATURE REVIEW

Challenge-Based Learning and Competences: Learning to Learn

According to Tecnológico Tecnológico de Monterrey (2016), challenge-based learning has its roots in experiential learning, which states that students learn better when they actively participate in open learning experiences, facilitates self-discovery, and offers opportunities to apply what they have learned in real and problem situations and test solutions and interact with other students in different contexts. Therefore, challenge-based learning is an integrative holistic approach to learning, which combines experience, cognition, and behavior (Akella, 2010) for the acquisition of long-term educational competences.

The concept of competence is a recent insertion in the educational curriculum. Its conceptual complexity and the different conceptualizations in the legislation of each country and European and international reports make this an imprecise and undefined concept (Loynes et al., 1997; Lee et al., 2020). The Organization for Economic Co-operation and Development provides the following definition (Organisation For Economic Co-Operation and Development (OECD), 2007, p. 8): "Key competences involve a mobilization of cognitive and practical skills, creative abilities and other psychosocial resources such as attitudes, motivation and values." In Spain, according to current educational legislation, the competences are relevant in terms of personal fulfillment, active citizenship, adult life, and work (Ministry of the Presidency, 2006, 2015; 2020).

Learning to learn competence is understood as the basis of learning (Jornet Meliá et al., 2012). Hautamäki et al. (2002, p. 39) define the learning to learn competence as "the ability and willingness to adapt to new tasks, by activating the commitment to think and a perspective of hope through the maintenance of cognitive and affective self-regulation in the learning activity." According to *Recommendation 2006/962/EC* (Publications Office of the European Union, 2006, p. 16), "Learning to learn is the ability to pursue and persist in learning, to organize one's own learning, including through

effective management of time and information, both individually and in groups." This competence addresses three educational dimensions (Drăghicescu et al., 2015): affective, cognitive, and metacognition.

As teacher trainers, a deep analysis of what we understand as learning is required to teach how to learn. This means, from a practical level, the exhaustive and detailed design of activities aimed to achieve this competence from any area of knowledge (Vázquez, 2009). Therefore, it is necessary to attend to different educational aspects involved in the teaching–learning processes, such as previous ideas, protagonism and autonomy, planning and realism, knowledge, skills and strategies, reflection and supervision, and evaluation.

Many authors defend the value of experiential learning for promoting the ability of learning to learn (Department for Education and Skills, 2006). In this sense, outdoor education in Social and Natural Sciences encourages this type of experiential learning (Dillon et al., 2006), including its relevance in the field of teacher training. The acquisition of skills has been achieved, for example, through qualitative analyses linked to the interpretation of landscapes (Morales et al., 2014), archaeological sites (Morón Monge et al., 2018), or visits to museums (Achurra and Morentin, 2017), with students of the Master's Degree, Primary Education Bachelor's Degree, and Early Childhood Education Bachelor's Degree, respectively.

In the Early Childhood Education stage, experiential learning takes on special importance, since the child explores and builds their world based on the direct interaction between their senses and the environment (Wilson, 1994; Cañal, 2006). The teaching situation under which this research is carried out is a museum education aimed at developing the learning to learn competence.

Museum Education

The CBL associated with the resources offered by museums is positive for bringing together aspects of school, society, and science. Therefore, the relations between museums, heritage, and education must maintain an interdisciplinary, holistic, constructivist, and sociocritical vision (Cuenca et al., 2013; Martín Cáceres et al., 2014) for the promotion of competences. Museums are important educational environments and offer a considerable learning potential: multifaceted experiential learning and as living environments during lifelong learning (Akamca et al., 2017).

Field trips in the teaching of social and natural sciences have been developed for a long time (Anderson et al., 2008). Their educational importance appears in the educational curricula of Spain, from the stage of Early Childhood Education to university education (Delgado and Alario, 1994; Romero Ariza, 2010; Cantó et al., 2013). Despite these circumstances, field trips in Spanish schools are usually carried out as nonscheduled activities, decontextualized from the educational program and from a traditional perspective of science (Costillo et al., 2014; Mateo, 2019).

The museums of the 21st century face the great challenge of attending to competency teaching by adapting their way of communicating to new technologies (Morales Agudo, 2015). The educational proposals of schools have been complemented with outdoor activities such as visits to museums or settlements/sites and colonies and Prehistory workshops (Boj, 2001). The learning scenarios can be numerous if the teacher knows how to use them. Each space (museums, parks, aquariums, botanical gardens, etc.) offers a multitude of educational opportunities where outdoor experiences can be developed (Morón-Monge et al., 2020).

Some educational experiences during the early childhood stage are developed in museums to work on specific knowledge, although without statistical analysis, such as that described by De los Reyes, (2009), through a proposal called the "children's classroom museum," aimed at children from 5 to 8 years of age, focused on children learning about the past from their relationships with the present. The daily objects used were turned into historical objects. Therefore, an inductive research method was employed for observation, description, documentation, classification, and interpretation, and it facilitated the valuation of cultural heritage (family and social).

Bardavio et al. (2013) undertook workshops and activities on the understanding and preservation of archaeological heritage. The results contributed to the modification of previous ideas (stereotypes), historical knowledge, active participation, and the rights and duties of citizens, through a didactic strategy of guided discovery.

Escribano-Miralles and Molina (2015) conducted a tour of the Ramón Gaya Museum (Murcia, Spain) from an inquiring perspective, with 5-year-old children. The qualitative and quantitative results confirmed the high degree of satisfaction and motivation of the students and their greater relationship with the artistic heritage. This was possible thanks to the development of four phases (questions, new information, structuring, and learning).

Domínguez Castro and Pineda Alfonso, (2019) developed an experience based on art and creativity, in fine arts centers of Seville (Spain), through activities and drawings for 5-year-olds, to overcome the traditional educational cards. The results of various activities contributed to an improvement in the originality and creativity of the students, through the use of a category system and a progression hypothesis.

At the international level, and from a nonformal education perspective, museums are increasing their services for very young children, offering a greater number of educational proposals adapted to infants (Bowers, 2012; Munley, 2012). However, there are still few outdoor experiences dedicated to Early Childhood Education (Monti et al., 2019) and fewer educational proposals developed for formal education in museums.

There are not many trips to museums with Social Sciences content in the training of Early Childhood Education teachers. Muñoz García and Jiménez Pablo, (2020) developed an experience in two museums in the Community of Madrid: National Museum of Anthropology (MNA) and Museum of America (MAM). Through a qualitative methodology, the development of social and civic competences and cultural expressions was promoted, revaluing the cultural heritage through dioramas and reproductions of houses typical of American indigenous cultures. The results made it possible to

detect, in undergraduate students, high levels of significance on training around cultural diversity.

We selected the Community of Madrid Regional Archaeological Museum, very close to the Santa María de la Providencia Early Childhood School. This educative institution is interdisciplinary, exhibits contents that cover areas of social and natural sciences, and shows the society and environment of the past. This museum can also work on other educational areas from a global approach, as recommended for the Early Childhood Education stage.

Due to COVID-19, we opted for the virtual tour. Although virtual exhibition spaces lack the contextual space of the physical visit (Orellana and Andreu, 2014), they present the following advantages: planning from home; facilities against geographical, physical, and economic impediments; and the display of numerous materials from other museums or located in warehouses (Arambarri and Baeza, 2012).

Education in COVID-19 times: e/m-Learning

In today's world, e/m-learning has a very important role, especially among the younger population born in the digital era of new information technologies. E-learning or electronic learning involves a multimedia system (text, audio, video, and imagery) for carrying out virtual training over the Internet (Bates, 2005), characterized by its simplicity of use and lack of distance between the transmitter and receiver, as well as the fact that it is economical for students, interactive, and accessible.

M-learning or mobile learning is a branch of m-learning with the following purpose: "Promote information collection and exchange, improve communication and collaborative interaction, encourage active learning, and enhance the learner's feedback process, and acquire content quickly" (Lan et al., 2012, p. 1124).

For our experience, CBL and an e/m-learning approach were integrated. This proposal is interesting for developing skills such as learning to learn, and it can act as a benchmark in times of pandemic. This approach is characterized by focusing on the student, who establishes their own work plan and formulates real, close, and observable problems that connect with their interest and that can be raised with the help of the teacher (Fernández-Ferrer and González-García, 2017). Likewise, virtual teaching entails a lower probability of contagion.

MATERIALS AND METHODS

Participants

This educational experience was carried out with a nonrandom group of 55 Early Childhood Preservice Teachers (third academic year, University of Alcalá, Spain), as part of the subjects Teaching and Learning of Social Sciences and Teaching and Learning of Natural Sciences, during 2020–2021 academic course. There were 52 women (94.55%) and 3 men (5.45%). The age of the participating sample is between 20 and 22 years. They were proposed to take part in the study voluntarily, and all participants responded. All ECPT were native Spanish speakers and born and raised in Spain, although two of them had an Ecuadorian background. The study was conducted according to the guidelines of the Declaration of Helsinki: informed consent, right to information, protection of personal data, guarantees of confidentiality, nondiscrimination, free of charge, and the possibility of abandoning the study on any phase.

Methodology

This research focuses on a quasiexperimental design according to a quantitative methodology. In general terms, quasiexperimental design aims to test a causal hypothesis by manipulating (at least) one independent variable where for logistical or ethical reasons it cannot be randomly assigned to the groups (Fernández et al., 2014). This research involves an analysis of the results of the implementation of an innovative didactic proposal regarding competence acquisition. From this perspective, we use an instrument shaped by different complex levels (Bisquerra, 2009; Krippendorff, 2013). The main evaluation instrument for this research is the ECPT's self-perception of their level of competence acquisition, and it was designed in Google Forms according to the Likert-type scale (scale 1–4). **Figure 1** synthetically presents the study.

Taking into account that a challenge is an activity, task or situation that involves the student a stimulus and a challenge to carry out, in this study the research question is *How do the ECPT improve the learning to learn competence after to the CBL and their experience in the virtual museum tour?* To approach this question, we designed a category system-like data collection and analysis instrument based on the European Commission (2012) about the learning to learn competence.

With this instrument, the ECPT's self-perception was assessed at two moments of the teaching and learning process (pretest and posttest). This experience is based on a CBL and e/m-learning approach. These educational proposals were evaluated with an evaluation rubric that complemented the results of self-perception. Although this study focuses on the self-perception of competence, assessing the process followed by the experience gives a holistic vision of the teaching–learning process developed.

Category System

We present a category system with four levels of progression for the evaluation of the acquisition of learning to learn competence (European Commission (2012, p. 15): "1. *Why I learn* (attitude towards learning and willingness to learn). 2. *What I learn* (setting objectives and planning activities), 3. *How I learn* (organized and targeted learning activities) and finally 4. *I reflect on my process* (reflection on learning activities and outcomes and self-assessment)." The Likert-type scale answers were as follows: (1) *first steps*, (2) *going in the right direction*, (3) *close to the target*, and (4) *competence acquired*.

Levels of learning progression are levels of complexity of knowledge from reductive to holistic thought (Morin, 1990; Alonzo and Steedle, 2009; Jin and Anderson, 2012). The category system justifies and structures the whole research (Cuenca et al., 2017; Abril-López et al., 2020).

The students accessed "Blackboard Learn" to fill in the questionnaire by levels of progression, which were disordered to avoid distortions. This system was implemented in the

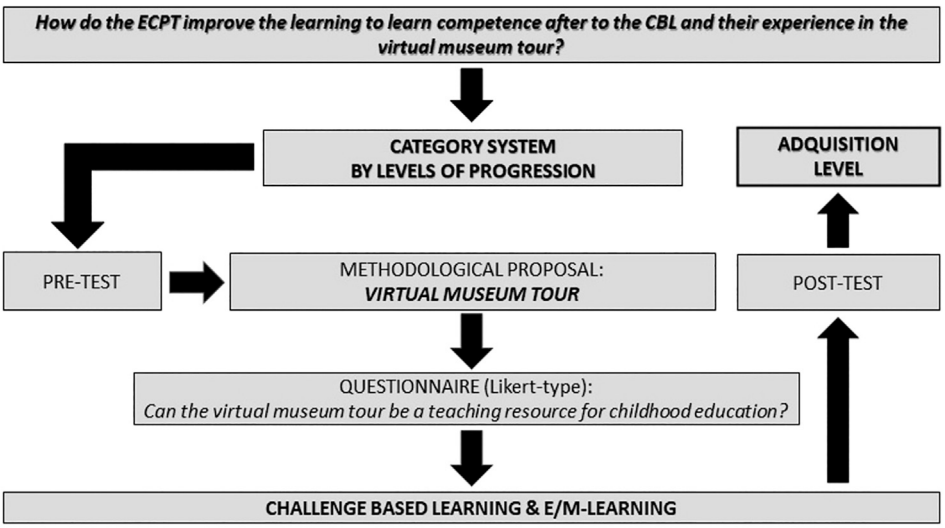

FIGURE 1 | Outline of the investigation.

FIGURE 2 | QR code of the category system by progression levels (pretest–posttest). Own elaboration based on the European Commission (2012).

Lithuanian educational system, which "demonstrates how the 'learning to learn' competence can be described as levels that help learners and their teachers to assess progress" (European Commission, 2012, p. 16).

This questionnaire was designed in Google Forms, which the students accessed from a QR code (**Figure 2**). The use of these open-access digital tools, through mobile devices, provides students with a positive, innovative, and current image of education (García-Tormo, 2018) and allows information to be collected in an efficient and effective manner (Pérez-Sanagustín et al., 2016).

The questionnaires were completed at two moments—before (pretest) and after the experience (posttest)—like other similar studies (Dugard and Todman, 1995; Solís-Espallargas and Morón-Monge, 2020).

PROCEDURE

The university degree students were proposed to take part in this study in the beginning of October 2020. Due to mobility restrictions due to COVID-19 affected Spanish schools, the students were not able to go to school to work with the infants or visit the Community of Madrid Regional Archaeological Museum with the children. Taking these circumstances into account, different challenges and materials were proposed on the three Prehistory rooms and their environmental context, thanks to e/m-learning, to bring MAR to the school environment.

Phase 1: Before the Virtual Tour

The teacher worked in the classroom, through Blackboard Learn, with the ECPT before the virtual tour. First, a debate was held to obtain prior knowledge on three main pillars, including competences, museums, and e/m-learning, through different questions: What are competences? What is the learning to learn competence? Why is it important? Are museums suitable spaces for acquiring skills and why? How can we work, in these institutions, on challenges for Early Childhood Education and applied e/m-learning? The responses manifested, mainly, substantive deficiencies: confusion in the meaning of the competences, stereotypes about museums, and few links between museums and e/m-learning.

FIGURE 3 | Community of Madrid Regional Archaeological Museum. **(A)** Facade of the museum. **(B)** Archaeological/paleontological excavation. **(C)** Prehistory (room "Before the time of Man"). **(D)** Paleoenvironment (palynology). **(E)** Paleoenvironment (fauna). **(F)** Hunting (arrowheads). **(G)** Domestication (cheese and container). **(H)** Harvesting and agriculture. **(I)** Lithic artifacts for everyday life. **(J)** Interior of a house. **(K)** Individual burial (social complexity).

Afterward, the general characteristics of the teaching experience were explained, including the e/m-learning tools (Blackboard Learn and websites) and information related to the Community of Madrid Regional Archaeological Museum (Márquez and Baquedano, 2004; Mendoza and Lliso, 2011; Community of Madrid Regional Archaeological Museum, 2021a).

Finally, the students organized themselves into working groups of five members. Each group (N = 11) selected one of the ten interdisciplinary challenges (Social and Natural Sciences), plus one storytelling, to investigate in the virtual tour of the museum based on data collection and collaborative and autonomous work.

Phase 2: Virtual Tour

The Community of Madrid Regional Archaeological Museum was opened in May 1999. Access to the museum is free. Within the building, there is a comfortable and clear, perfectly demarcated tour around the permanent exposition regarding different settlers' past lives and cultures since the Paleolithic (Márquez and Baquedano, 2004).

The virtual tour can be viewed through PCs, tablets, and smartphones. It includes photos, videos, descriptions of materials (stone, ceramic objects, bronze, iron, etc.), and 360° panoramic views of the nine rooms of the permanent exposition. The objects reveal center Iberian Peninsula inhabitants' way of living: houses, clothing, work, leisure, food, etc. (Community of Madrid Regional Archaeological Museum, 2021b).

We consider the Community of Madrid Regional Archaeological Museum to be very important for the Early Childhood Education stage (3–6 years). It contains very diverse and appropriate materials to explain socioeconomic relations, the environmental context, and differences and similarities with the present time. The museum also incorporates a virtual tour.

During the virtual tour, the ECPT freely observed the exhibition, collecting data on the museum that they believed were relevant to answering the research question posed (**Figure 3**). To complement this observation, the ECPT was offered a questionnaire designed by the teachers and accessed by a QR code (**Figure 4**). The Likert-type questionnaire, with values ranging from 1 to 5 (from least agreement to most agreement), allowed various questions about the museum, in terms of both form and content (virtual tour, adaptations, Information and Communication Technology (ICT)/Learning and Knowledge Technologies (LKT), didactic workshops, sociocritical discourse, complete and diverse contents, interdisciplinary contents, attitudinal contents, didactic documentation, and the relationship between activities and the museum), to be assessed.

Phase 3: After the Virtual Tour

After, in the classroom, the ECPT shared their experience with the whole class. The data collected were shared, in addition to the evaluations made from the questionnaire about the virtual tour (Likert-type). In relation to the challenges/storytelling (10 + 1)

FIGURE 4 | QR code for accessing the questionnaire about the virtual tour.

discussed, different issues, potentialities, and weaknesses of each topic were assessed as an educational resource for Early Childhood Education.

First, a team from ECPT created storytelling so that children could easily internalize the content. In other words, each challenge began with an oral, emotional, motivating story, and a quick and effective connection (Robin, 2006; Sánchez-Vera et al., 2019). In addition, the storytelling is associated with a didactic guide that helped the Early Childhood Education teachers to carry out the manipulative activities associated with the ten challenges.

After the exposition of the storytelling, the ten challenges were exhibited by each team with e-learning, and there were interactions with the rest of the students (feedback). The essentials questions associated with the challenges were the following: (1) What does an archaeologist/paleontologist study do? (2) What tools does he use? (3) What is Prehistory/Paleontology? (4) What fauna and flora coexisted with humans in Prehistory? (5) Was the fauna hunted or domesticated? (6) Was the flora collected or cultivated? (7) How did they hunt, gather, or fish? (8) Where did prehistoric people live? (9) What was the clothing of these settlers? (10) Were there inequalities in society? The challenges/storytelling incorporated big ideas related to current affairs (climate change, sustainability, conflicts, and economy), and they allowed the realization of activities with different objectives, competences, contents, methodology, assessment, etc.

The established teams made videos of the challenges/storytelling adapted to 5-year-old students. QR codes linked to YouTube were created. Later, the Early Childhood Education teachers shared it with their students (**Figure 5**).

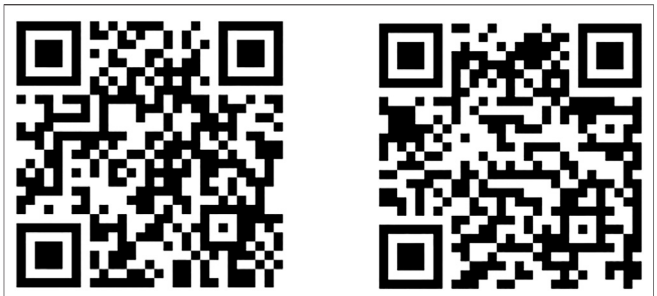

FIGURE 5 | QR code to view videos related to the MAR (virtual tour): challenge 1 (left) and challenge 6 (right).

Teaching challenges/storytelling was evaluated with a rubric organized into four complexity levels and seven variables based on the main educational elements for the teaching–learning process (**Table 1**). This modified rubric was validated during the experience of the Guadalajara Museum (Spain) (Abril-López et al., 2021). As we have justified, our main data analysis involved the ECPT's self-perception, but we also considered analyses on the teaching activities designed by the ECPT, to obtain a more holistic view of the teaching and learning process.

RESULTS

The results shown here correspond to the pre- and posttest questionnaires. The four levels of complexity, based on the European Commission (2012), appear in the QR code (see **Figure 2**): (I) first steps; (II) going in the right direction; (III) close to the target; and (IV) full competence acquired. The results do not show percentage differences based on the different challenges/storytelling.

As we can see in **Figure 6** (pretest), the ECPT considers that they exhibit level III and level IV for the four assessed dimensions: 1, 39 = 70.91% (level IV); 2, 33 = 60.00% (level III); 3, 32 = 58.18% (level III); and 4, 36 = 65.45% (level IV). Dimension 2 (What I learn) was the lower level IV chosen by the ECPT: 14 = 25.45%.

In relation to the lower levels of I and II, their sum is below 25% of the total for the four levels. The maximum value of level I corresponds to the fourth dimension (8 = 14.55%), while in level II, it corresponds to the four dimensions (I reflect on my progress), with a value of 4 = 7.27%.

The results of the posttest are presented in **Figure 7**. The highest results of the four dimensions can be observed for level IV or the reference level. Level I is nonexistent in the first dimension; the other three variables do not reach 11% of the total responses. Level II also shows a large decrease (below 8%), being between 0.00% ($N = 0$) and 7.27% ($N = 4$) for the first/second and third variables, respectively.

Level III (close to the target) was the second most chosen by the students for the four variables: 1, 10 = 18.18%; 2, 11 = 20.00%; 3, 18 = 32.73%; and 4, 5 = 9.09%. It surpassed the data of the previous levels (I and II). Finally, level IV obtained the best scores, since the evolution with respect to the pretest is noticeable for the

TABLE 1 | Rubric for evaluating ECPT's challenge-based learning.

Variables	Level	Descriptors
Title, sections, and internal structure	I	The title does not correspond to the content of the challenge/storytelling, the internal structure is incoherent, and the information is not balanced.
	II	There is some coherence, but there is a lack of balance in the development of the sections. There is irrelevant information.
	III	There are coherence problems (inappropriate title, some underdeveloped section), but a logical structure is maintained.
	IV	The title is didactic and meaningful, it includes the required sections, and they are developed in a coherent and balanced way.
Justification, objectives and competences	I	The challenge/storytelling has no justification. There are neither objectives nor they are they formulated based on the visit museum. There are no competences.
	II	Justification is inadequate. Many goals are inconsistent. Competences are not related to objectives.
	III	There is justification. Most of the objectives are properly planned. Competences are related to objectives.
	IV	Strong justification. Challenge/storytelling with related objectives and competences, and adapted for Early Childhood Education students.
Contents	I	Mainly conceptual content. There is no adaptation for Early Childhood Education students.
	II	Procedural and attitudinal contents are included.
	III	Consistent information: from simplicity to complexity.
	IV	Contents with problems, both past (Prehistory) and current (real world). Idea of global importance.
Methodology	I	Methodology is not consistent with the challenge/storytelling and does not allow the transmission and assimilation of content observed in the virtual tour.
	II	Methodology shows important weaknesses for the transmission of content.
	III	Methodology is coherent, although it contains some weaknesses for the assimilation of the contents.
	IV	Methodology has been correctly selected for the transmission and assimilation of the contents to the students of Infant Education.
Conclusions	I	There are no conclusions, or they are not consistent. There are no proposals for improvement based on the knowledge acquired and the conclusions reached.
	II	Conclusions are not adequate for lack of reflection and synthesis. There are inconsistent improvement proposals.
	III	Conclusions are generally consistent in accordance with the objectives. There are some suggestions for improvement.
	IV	Conclusions are accurate and consistent with the objectives, providing data with a critical sense. There are excellent proposals for improvement: solution—action.
References	I	Virtually all sources are unreliable or out of date. Most of them are incorrectly referenced.
	II	More than 30% of references come from unspecialized or outdated sources. There is confusion about the authorship of some citations.
	III	Some references come from unspecialized sources. Most of the references are well used and correctly attributed.
	IV	Sources come from specialized publications and are diverse and up-to-date. All references are well used and attributed.
Spelling and syntax	I	There are serious problems with spelling, syntax, and grammar.
	II	There are more than 30% of problems with spelling, syntactic, or grammatical rules.
	III	There are few spelling, syntactic, or grammatical errors.
	IV	The text does not contain any spelling, syntactic, or grammatical problems.

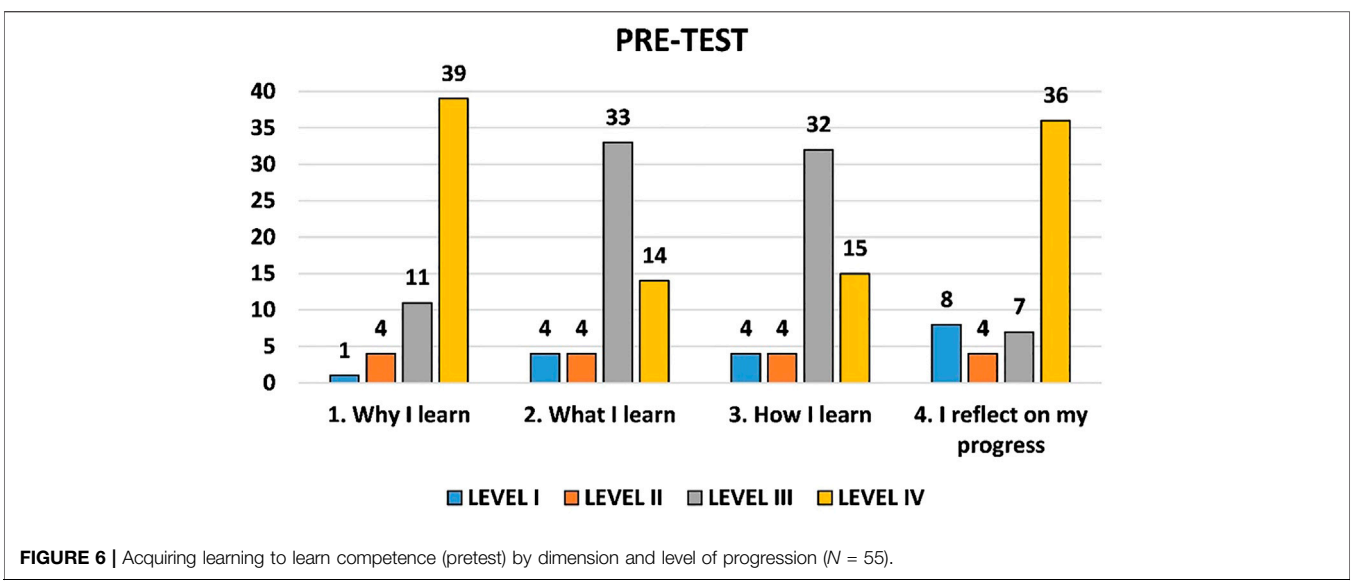

FIGURE 6 | Acquiring learning to learn competence (pretest) by dimension and level of progression (N = 55).

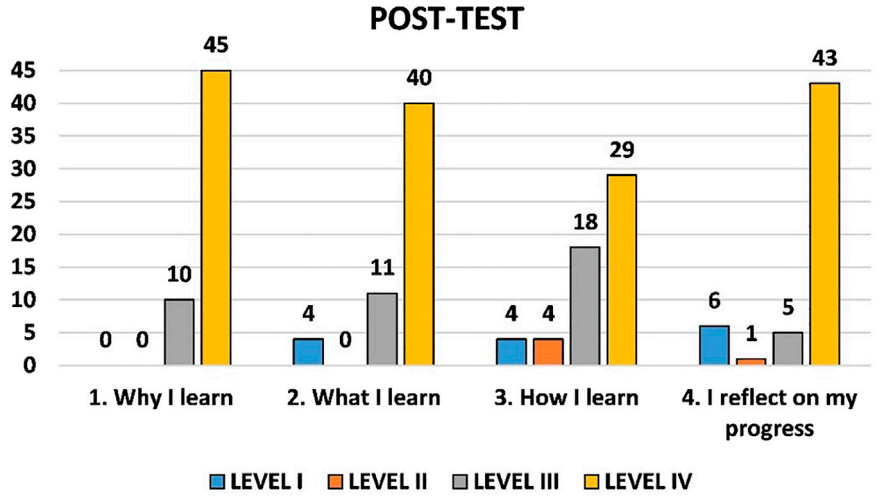

FIGURE 7 | Acquiring learning to learn competence (posttest) by dimension and level of progression (N = 55).

TABLE 2 | Skewness, kurtosis, and p values for normality Shapiro test.

Score	Skewness	Kurtosis	Shapiro test's p values
Item 1-Pre	−1.77	5.53	$p < 0.001$
Item 2-Pre	−0.96	4.08	$p = 0.003$
Item 3-Pre	−0.96	4.00	$p = 0.002$
Item 4-Pre	−1.24	2.92	$p < 0.001$
Total score-pre	−1.35	4.45	$p < 0.001$
Item 1-Post	−1.77	5.24	$p < 0.001$
Item 2-Post	−2.21	7.09	$p < 0.001$
Item 3-Post	−1.26	3.80	$p < 0.001$
Item 4-Post	−1.99	5.36	$p < 0.001$
Total score-post	−1.30	3.98	$p < 0.001$

four variables: 1, 45 = 81.82%; 2, 40 = 72.73%; 3, 29 = 52.73%; and 4, 43 = 78.18%. The most prominent dimensions are 1 ("Why I learn") and 4 ("I reflect on my progress").

If we compare the pre- and posttest results, for levels I and II of the four dimensions, percentage variation is observed, especially for dimensions 1 and 2 of level II: 7.27% versus 0.00%. At level IV, an increase can be observed for all dimensions: 1, 70.91% versus 81.82% = +10.91%; 2, 25.45% versus 72.73% = +47.45%; 3, 27.27% versus 52.73% = +25.46%; and 4, 65.45% versus 78.18% = +12.73%. In short, these self-perception data show the progress of the acquisition of competence after the experience carried out.

With the contrast of all previous data, a total score for each of the two questionnaire administrations was calculated. As a result, we accounted for 10 quantitative scores for each of the 55 participants, namely, four scores and one total score from each of the two pre-post questionnaires administrations. Although the sample size criteria for big sample is met (sample size >50) and consequently we could have well used a paired Student test for pre-post comparison for the intrasubject 5 scores available, we firstly checked kurtosis and skewness, and Shapiro tests for each of the scores were performed. As **Table 2** shows, none of the scores have a normality distribution, namely, skewness = 0 and kurtosis = 3. Additionally, Shapiro tests for normality are statistically significant for all scores calculated. These data show considerable deviance from normal distribution; therefore, we decided to use the nonparametric paired-samples Wilcoxon test to compare each of the four pre-post and the pre-post total scores.

In relation to Item 1, pre-post comparison paired-samples Wilcoxon test result shows a statistically significant difference (p = 0.008). Item 2 pre-post comparison paired-samples Wilcoxon test result shows a statistically significant difference (p > 0.001). Item 3 pre-post comparison paired-samples Wilcoxon test result shows a statistically significant difference (p = 0.003). Item 4 pre-post comparison paired-samples Wilcoxon test result shows a statistically significant difference (p = 0.006). Finally, total score pre-post comparison paired-samples Wilcoxon test result shows a statistically significant difference (p > 0.001).

DISCUSSION

In Spain, there are not many educational experiences in childhood teacher training like the one described herein. Studies on competence acquisition and outdoor experiences (Achurra and Morentin, 2017; Morales et al., 2014; Morón Monge et al., 2018; Muñoz García and Jiménez Calvo, 2020), and others (Codes, 2017; Sanz and Zuzuarregui, 2017; Morón-Monge et al., 2020), show a qualitative methodology based on three major phases: initial (students' previous ideas), development (direct and systematized observation), and evaluation (research and didactic proposals). The use of instruments for the collection of information and data analysis provides results that are mainly the product of description, interpretation, and reflection.

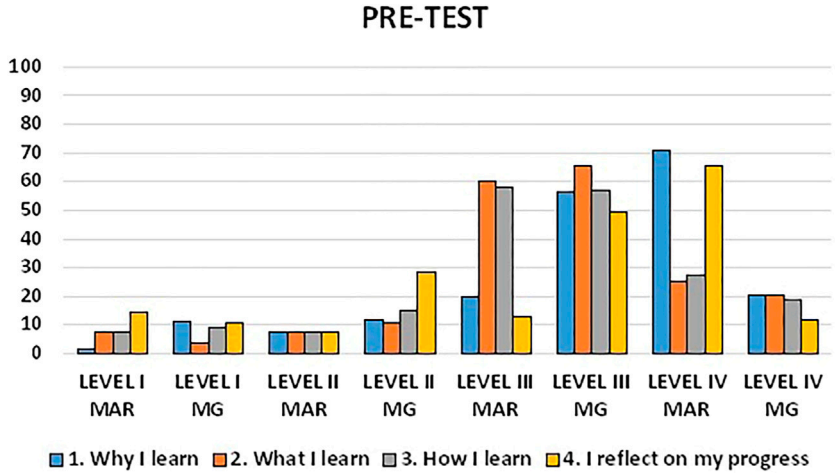

FIGURE 8 | MAR vs. MG (pretest): levels of achievement of the four dimensions.

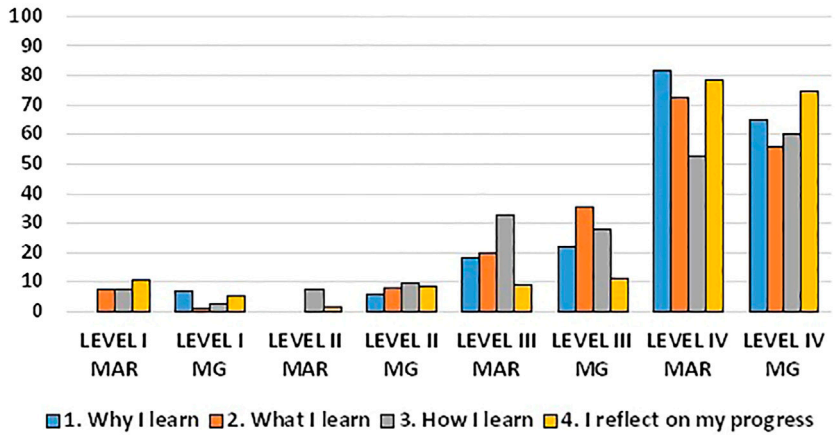

FIGURE 9 | MAR vs. MG (posttest): levels of achievement of the four dimensions.

In our case, together with the category system (see **Figure 2**), questionnaire about the virtual tour (see **Figure 4**), and evaluation rubric (see **Table 1**), we developed a quantitative methodology (quasiexperimental design) pretest–posttest with statistical analysis. On the other hand, we work on an innovative triple didactic link: the acquisition of the learning to learn competence thanks to the development of 10 + 1 challenges/storytelling (CBL) related to the virtual museum tour (e/m-learning).

In this sense, we can obtain some reflections after the comparative analysis between two very similar studies on competence acquisition, related to the Community of Madrid Regional Archaeological Museum (MAR) and the Museum of Guadalajara (MG) (Abril-López et al., 2021). The system of categories by level of progression on the competence learning to learn showed visible differences between the pretest phase and the posttest phase for the four dimensions.

Figure 8 shows the results of the pretest. Levels I and II are not very relevant in both cases. In the MAR experience, we highlight higher values in dimension 1 ("Why I learn") in levels III and IV. It seems that, from an educational perspective, students attribute the greatest importance to reflection and search for solutions to different problems, past and current, for the benefit of the social majorities, as we evaluate in their challenges. Johnson et al. (2009) expressed these conclusions after a study on the CBL in six schools in the United States. The experience in the MG yielded more traditional previous knowledge, since dimension 2 ("What I learn") predominates in levels III and IV; Maynard and Waters (2007) also observed this vision of teaching in practicing Early Childhood Education teachers in South Wales, giving greater importance to content-based learning.

TABLE 3 | MAR (Community of Madrid Regional Archaeological Museum) vs. MG (Museum of Guadalajara), acquiring learning to learn competence (pretest–posttest)—descriptive statistics.

Learning to learn	μ		σ		Coefficient of variation (%)	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
1. Why I learn	3.6/2.9	3.8/3.5	0.3/0.9	0.2/0.9	9/30	5/26
2. What I learn	3.0/3.0	3.6/3.5	0.4/0.7	0.4/0.7	12/22	11/20
3. How I learn	3.1/2.9	3.3/3.5	0.4/0.8	0.4/0.8	12/29	12/22
4. I reflect on my progress	3.3/2.6	3.5/3.6	0.5/0.8	0.4/0.9	16/31	13/24

After the educational experience (**Figure 9**), levels I and II are not significant in the two cases. In the MAR experience, dimension 3 ("How I learn"), related to the use of different learning methods and various information sources, most of them are at level III; and dimension 1 was again the most numerous in level IV. In the experience at MG, dimension 2 prevailed again at level III; dimension 4 ("I reflect on my progress"), in level IV, increased from 18.99% (pretest) to 74.81% (posttest). The ECPT, in the posttest of the two experiences, attaches greater importance to changes attitudes and behaviors, reflecting on their own learning process in an autonomous way: it is related to metacognition and is considered a transversal competence of the curriculum (Hoskins and Fredriksson, 2008).

Statistically (**Table 3**), in relation to the four dimensions that were analyzed, after the two experiences, the ECPT practically reached level IV in the posttest. However, there are some differences, partly linked to the sample number: MAR (N = 55) versus MG (N = 258). First, the mean or average (μ) pretest–posttest progresses at a lower rate than the MG experience; that is, there is greater self-perception in the initial acquisition of the learning to learn competence. Second, the standard deviation (σ) and coefficient of variation (CV) of the MAR experience show less dispersion of the data or greater homogeneity.

This translates—along with the results of the rubrics for the evaluation of the students—into an improvement in self-confidence, autonomous and cooperative work, enthusiasm, responsibility, planning, new challenges, completion of tasks on time, successful goals, and, finally, an evident increase in the acquisition of the learning to learn competence. In this experience, the rubric results were high: 65% for levels III-IV, 25% for levels II-III, and just 10% for level II.

This study is based on an approach of the level of achievement of the learning to learn competence from ECPT's perception and complemented these results with their teaching activities. The study could be enhanced by the implementation of other improvements:

- We must increase the sample size and add control groups.
- We need to replicate this research with other challenge-based learning projects/contents.
- COVID-19 pandemic limited our initial research design as it was planned to do an actual visit to the Museum. Results obtained would have probably been even more telling.
- Other measures/questionnaires apart from the one used are desirable so we can double-check the learning to learn competence.

In short, this work should be understood as an approximation to the phenomenon that has served to validate both the category system and the rubric described here and that will be used and improved in future experiences.

CONCLUSION

As teacher educators, based on the results obtained in this experience, we highlight three important educational teaching implications. First, the interdisciplinary CBL has involved the adequate design of strategies to allow the acquisition of learning to learn competence, as reflected in the state educational curriculum, and the reflective and decisive training of students (Muñoz, 2009; Vieites, 2009; Ureña, 2013) in the face of past, present, and future problems. In addition, other transversal competences were developed, such as collaborative and multidisciplinary work, ethics, and leadership, as well as in a multitude of challenges (Tecnológico de Monterrey, 2016). In this sense, we achieved results where there is a progression in the teaching and learning processes, evidenced in both the category system and the rubric.

Second is the importance of museum education and the use of e/m-learning tools for the acquisition of competences in the ECPT. Not all museum education has the same implication in the teaching–learning processes, since, in many cases, they are a reproduction of the indoor lesson (Maynard and Waters, 2007). The virtual tour has led to a different context of the classroom that allows the proximity of the ECPT to other didactic environments. The students from the virtual museum tour improved the learning to learn competence, as a basis of learning for life (Akamca et al., 2017). We highlight the need to design virtual tour with a challenge-based learning, in order to improve the scientific knowledge and skills required to solve social and natural problems. But virtual tours must include adequate technologies—satisfactory design of the webpages, three-dimensional (3D) environments, and worldwide web technologies—and supplementary contents which could be of use for learning purposes (Kabassi et al., 2019). During the COVID-19 pandemic, museums should take up the challenge of spreading knowledge in virtual space and treat it as a mission in which the reward is to build economic diversification, new jobs

and revenues through the development of cultural and creative quarters, diffusion of creativity, and identity and education to worldwide communities (Gutowski and Klos-Adamkiewicz, 2020).

Third, and connected with the above, it is necessary that the museums be adapted to Early Childhood Education (Bowers, 2012; Munley, 2012). We obtained this observation from the analysis carried out in the Community of Madrid Regional Archaeological Museum as an educational resource for early childhood education. The virtual museum tour is an optimal didactic alternative under the COVID-19 pandemic, according to the result of the questionnaire (see **Figure 4**). This virtual tour, on the other hand, presents deficiencies for the Early Childhood Education student. There are questions that did not exceed 50% if we only included the scores 4 (agree) and 5 (strongly agree): the adaptation for the 5-year-old students; the technological resources; and the didactic workshops. However, the Museum of Guadalajara provided worse results (Abril-López et al., 2021): it does not present resources that favor manipulation or interaction with the visitor, or that invite the exhibition, all of which are relevant issues for learning in the Early Childhood Education stage. Despite this, the two experiences present other interesting educational possibilities for children in early childhood education, such as diversity of the material register, that benefits past–present (and future) comparatives and complete—conceptual, procedural, attitudinal—and interdisciplinary contents.

The adaptation of the challenges/storytelling, due to the COVID-19 situation and the contribution of the Early Childhood Education teachers, resulted in the design and development of different activities, carried out both inside and outside the classroom. Thanks to the virtual tour and the analysis and interpretation of the material record of the rooms of Prehistory, teaching–learning processes for the knowledge of the environment were developed. The evaluation of the 5-year-old students was quite satisfactory and was based on the analysis of previous knowledge, direct observation, the development of activities with questions to verify the objectives achieved, and a final self-evaluation rubric.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

DA was the primary author of the manuscript. DA and DL conceived and designed the project of which this study is part. DA and DL wrote the first draft of the manuscript. ED and PG both contributed to revisions and read and approved the submitted manuscript.

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REFERENCES

Abril-López, D., Morón-Monge, H., Morón-Monge, M. d. C., and López Carrillo, M. D. (2021). The Learning to Learn Competence in Early Childhood Preservice Teachers: An Outdoor and e/m-Learning Experience in the Museum. *Future Internet* 13 (2), 25. doi:10.3390/fi13020025

Abril-López, D., Morón-Monge, M. C., Morón-Monge, H., and Cuenca-López, J. M. (2020). The treatment of socioeconomic inequalities in the Spanish curriculum of the compulsory secondary education (ESO): An opportunity for interdisciplinary teaching. *Soc. Sci.* 9 (6), 94. doi:10.3390/socsci9060094

Achurra, A., and Morentin, M. (2017). *Análisis del modelo del profesorado en formación sobre las salidas didácticas en Educación Infantil*. Enseñanza de las Ciencias *núm. extra, 2041–2046*. Available at: https://raco.cat/index.php/Ensenanza/article/view/336780/427563 (Accessed July 3, 2021).

Adell, J. (2004). Internet en la Educación. *Comunicación y Pedagogía*. *Recursos Didácticos* 220, 25–28. Available at: https://elbonia.cent.uji.es/jordi/wp-content/uploads/docs/Comunicacion_y_Pedagogia_def.pdf (Accessed April 8, 2021)

Akamca, G. O., Yildirim, R. G., and Ellez, A. M. (2017). An alternative educational method in early childhood: Museum education. *Educ. Res. Rev.* 12 (14), 688–694. doi:10.5897/ERR2017.3145

Akella, D. (2010). Learning together: Kolb's experiential theory and its application. *J. Manag. Organ.* 16 (1), 100–112. doi:10.5172/jmo.16.1.100

Alonzo, A. C., and Steedle, J. T. (2009). Developing and assessing a force and motion learning progression. *Sci. Ed.* 93 (3), 389–421. doi:10.1002/sce.20303

Anderson, D., Piscitelli, B., and Everett, M. (2008). Competing agendas: Young children's museum field trips. *Curator Mus. J.* 51, 253–273. doi:10.1111/j.2151-6952.2008.tb00311.x

Arambarri, J., and Baeza, U. (2012). Museos Virtuales. Un caso práctico: Museo Nacional de Arqueología Subacuática (ARQVA). *Virtual Archaeology Rev.* 3 (7), 31–33. Available at: https://riunet.upv.es/bitstream/handle/10251/139165/Arambarri%3bBaeza%20-%20Museos%20Virtuales.%20Un%20caso%20pr%c3%a1ctico%3a%20Museo%20Nacional%20de%20Arqueolog%c3%ada%20Subacu%c3%a1tica%20%28....pdf?sequence=1&isAllowed=y (Accessed April 10, 2021).

Bardavio, A., Mañé, S., Pizarro, J., and Vila, M. (2013). Una experiència integrada d'educació i investigació prehistòrica. El Camp d'Aprenentatge de la Noguera. *Treballs d´Arqueologia* 19, 105–120. doi:10.5565/rev/tda.8

Bates, A. W. (2005). *Technology, E-Learning and Distance Education*. 2nd ed. Abingdon: Routledge. doi:10.4324/9780203463772

Bisquerra, R. (2009). *Metodología de la Investigación Educativa*. 2nd ed. Madrid: La Muralla.

Márquez, B., and Baquedano, E. (2004) *Guía del Museo Arqueológico Regional de la Comunidad de Madrid* (Madrid: Museo Arqueológico Regional de Madrid).

Boj, I. (2001). La didáctica de la prehistoria como instrumento de transformación social. *Íber* 29, 19–26.

Bowers, B. (2012). A look at early childhood programming in museums. *J. Mus. Edu.* 37 (1), 39–47. doi:10.1080/10598650.2012.11510716

Cañal, P. (2006). La alfabetización científica en la infancia. *Aula de Infantil* 33, 5–9.

Cantó, J., Hurtado, A., and Vilches, A. (2013). *Una propuesta de actividades "fuera del aula" sobre sostenibilidad para la formación del profesorado*. Spain: Enseñanza de las Ciencias núm, 638–642. Available at: https://ddd.uab.cat/pub/edlc/edlc_a2013nExtra/edlc_a2013nExtrap638.pdf (Accessed April 18, 2021).

Codes, M.AIDIPE (2017). "Una experiencia en formación de maestros de Educación Infantil a través del Arte," in *Actas XVIII Congreso Internacional de Investigación Educativa: interdisciplinariedad transferencia* (Salamanca: Universidad de Salamanca), 1275–1279. Available at: https://gredos.usal.es/handle/10366/137294 (Accessed July 5, 2021).

Community of Madrid Regional Archaeological Museum (2021a). *Collection*. Available at: http://www.museoarqueologicoregional.org/cs/Satellite?c=Page&cid=1158849749056&language=es&pagename=Museos%2FPage%2FMUSE_portadillaDosColumnas (Accessed April 10, 2021).

Community of Madrid Regional Archaeological Museum (2021b). *Virtual tour*. Available at: http://www.madrid.org/media/cultura/TourVirtual/Museo_Arq_Regional.htm (Accessed April 10, 2021).

Costillo, E., Borrachero, A. B., Villalobos, A. M., Mellado, V., and Sánchez, J. (2014). Utilización De La Modelización Para Trabajar Salidas Al Medio Natural En Profesores En Formación De Educación Secundaria. *Bio* 7 (13), 165–175. doi:10.17227/20271034.vol.7num.13bio-grafia165.175

Cuenca, J. M., Estepa, J., Jiménez, R., Martín, M., and Wamba, A. M. (2013). "Patrimonio y Educación: Quince años de investigación," in *La Educación Patrimonial en la Escuela y el Museo: Investigación y Experiencias*. Editor J. Estepa (Huelva: Universidad de Huelva), 13–24.

Cuenca, J. M., Estepa, J., and Martín, M. J. (2017). Heritage, education, identity and citizenship. Teachers and textbook in compulsory education. *Revista de Educación* 375, 131–152. doi:10.4438/1988-592X-RE-2016-375-338

De los Reyes, J. L. (2009). Del patrimonio cultural al museo infantil. *Tarbiya* 40, 107–124. Available at: https://revistas.uam.es/tarbiya/article/view/7186/7512 (Accessed March 11, 2021).

Delgado, J. E., and Alario, M. T. (1994). La interacción fuera del aula: itinerarios, salidas y paseos. *Tabanque* 9, 155–178. Available at: https://dialnet.unirioja.es/revista/1396/A/1994 (Accessed April 20, 2021).

Department for Education and Skills (2006). *Learning Outside the Classroom. Manifesto*. Available at: http://www.lotc.org.uk/wp-content/uploads/2011/03/G1.-LOtC-Manifesto.pdf (Accessed April 17, 2021).

Dillon, J., Rickinson, M., Teamey, K., Morris, M., Choi, M. Y., Sanders, D., et al. (2006). The value of outdoor learning: Evidence from research in the UK and elsewhere. *Sch. Sci. Rev.* 87 (320), 107–111. Available at: https://www.researchgate.net/publication/287621860_The_value_of_outdoor_learning_Evidence_from_research_in_the_UK_and_elsewhere (Accessed April 9, 2021).

Domínguez Castro, I., and Pineda Alfonso, J. A. (2019). Arte y creación en el aula de Infantil. *Ie* 97, 64–83. doi:10.12795/ie.2019.i97.05

Drăghicescu, L. M., Cristeab, S., Petrescua, A.-M., Gorghiuc, G., and Gorghiu, L. M. (2015). The learning to learn competence–Guarantor of personal development. *Proced. - Soc. Behav. Sci.* 191, 2487–2493. doi:10.1016/j.sbspro.2015.04.571

Dugard, P., and Todman, J. (1995). Analysis of Pre-test-Post-test Control Group Designs in Educational Research. *Educ. Psychol.* 15 (2), 181–198. doi:10.1080/0144341950150207

Escribano-Miralles, A., and Molina, S. (2015). *La importancia de salidas escolares y museos en la enseñanza de las ciencias sociales en Educación Infantil. Análisis de un caso a partir del modelo CIPP*. Clío 41 Available at: http://clio.rediris.es/n41/articulos/EscribanoMolina2015.pdf (Accessed April 26, 2021).

European Commission (2012). *Commission Staff Working Document. Assessment of Key Competences in Initial Education and Training: Policy Guidance*. Strasbourg: European Commission. FIN:EN:PDF Available at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2012:0371 (Accessed April 25, 2021).

Fernández, P., Vallejo, G., Livacic-Rojas, P., and Tuero, E. (2014). Validez Estructurada para una investigación cuasi-experimental de calidad. Se cumplen 50 años de la presentación en sociedad de los diseños cuasi-experimentales. *analesps* 30 (2), 756–771. doi:10.6018/analesps.30.2.166911

Fernández-Ferrer, G., and González-García, F. (2017). Salidas de campo y desarrollo competencial. *Enseñanza de las Ciencias de la Tierra* 25 (3), 295–301. Available at: https://www.raco.cat/index.php/ECT/article/view/330134/420944 (Accessed April, 2021)

García- Tormo, J. V. (2018). Aplicación de TICS (Formulario on-line) como metodología docente activa en estudios de postgrado. *Revista INFAD de Psicología* 3 (1), 199–208. doi:10.17060/ijodaep.2018.n1.v3.1257 Available at: http://www.infad.eu/RevistaINFAD/OJS/index.php/IJODAEP/article/view/1257/1096 (Accessed April 29, 2021).

Gutowski, P., and Kłos-Adamkiewicz, Z. (2020). Development of e-service virtual museum tours in Poland during the SARS-CoV-2 pandemic. *Proced. Comp. Sci.* 176, 2375–2383. doi:10.1016/j.procs.2020.09.303

Hautamäki, J., Arinen, P., Eronen, S., Hautamäki, A., Kupiainen, S., Lindblom, B., et al. (2002). *Assessing Learning-to-learn. A framework*. Helsinki: University of Helsinki.

Hoskins, B., and Fredriksson, U. (2008). *Learning to Learn: What is it Can it Be Measured?* Ispra: European Commission. Available at: https://www.diva-portal.org/smash/get/diva2:128429/FULLTEXT01.pdf (Accessed May 11, 2021).

Jin, H., and Anderson, C. W. (2012). A learning progression for energy in socio-ecological systems. *J. Res. Sci. Teach.* 49, 1149–1180. doi:10.1002/tea.21051

Johnson, L. F., Smith, R. S., Smythe, J. T., and Varon, R. K. (2009). *Challenge-based Learning: An Approach for Our Time*. Austin: The New Media Consortium. Available at: https://files.eric.ed.gov/fulltext/ED505102.pdf (Accessed April 9, 2021).

Jornet Meliá, J. M., García-Bellido, R., and González-Such, J. (2012). Evaluar la competencia aprender a aprender: Una propuesta metodológica. *Profesorado* 16, 103–123. Available at: https://www.ugr.es/~recfpro/rev161ART7.pdf (Accessed April 28, 2021)

Kabassi, K., Amelio, A., Komianos, V., and Oikonomou, K. (2019). Evaluating museum virtual tours: the case study of Italy. *Information* 10 (11), 351. doi:10.3390/info10110351

Krippendorff, K. (2013). *Content Analysis: An Introduction to its Methodology*. 3rd ed. Thousand Oaks: Sage.

Lan, Y.-F., Tsai, P.-W., Yang, S.-H., and Hung, C.-L. (2012). Comparing the social knowledge construction behavioral patterns of problem-based online asynchronous discussion in e/m-learning environments. *Comput. Edu.* 59 (4), 1122–1135. doi:10.1016/j.compedu.2012.05.004

Lee, H., Stern, M. J., and Powell, R. B. (2020). Do pre-visit preparation and post-visit activities improve student outcomes on field trips? *Environ. Edu. Res.* 26 (7), 989–1007. doi:10.1080/13504622.2020.1765991

Loynes, C., Michie, D., and Smith, C. (1997). "Justifying outdoor education in the formal and informal curriculum„" in *A Guide for Outdoor Educators in Scotland*. Editors P. Higgins, C. Loynes, and N. Crowther (Penrith: Adventure Education), 15–21.

Martín Cáceres, M., López Cruz, I., Morón, H., and Ferreras, M. (2014). *La educación patrimonial en los museos. Análisis de materiales didácticos*. Clío 40 Available at: http://clio.rediris.es/n40/articulos/martincaceres.pdf (Accessed March 25, 2021).

Mateo, M. R. (2019). "Las salidas de campo en el medio rural. Análisis de las investigaciones presentadas a congresos del grupo de trabajo de didáctica de la geografía de la AGE y de la APG (1988-2016)," in *La Reconfiguración del Medio Rural en la Sociedad de la Información. Nuevos Desafíos en la Educación Geográfica*. Editors X. Macía, F. Armas, and F. Rodríguez (Santiago de Compostela: Andavira), 1279–1292. Available at: http://didacticageografia.age-geografia.es/docs/Publicaciones/2019_IX_Congreso_Iberico.pdf (Accessed May 12, 2021).

Maynard, T., and Waters, J. (2007). Learning in the outdoor environment: A missed opportunity?. *Early Years* 27 (3), 255–265. doi:10.1080/09575140701594400

Mendoza, R., and Lliso, M. (2011). *Viviendo la Prehistoria en el Valle del Lozoya*. Madrid: Museo Arqueológico Regional de Madrid.

Ministry of the Presidency (2006). *Ley Orgánica 2/2006, de 3 de mayo, de Educación*. Madrid: Boletín Oficial del Estado. Available at: https://www.boe.es/boe/dias/2006/05/04/pdfs/A17158-17207.pdf (Accessed May 8, 2021).

Ministry of the Presidency (2020). *Ley Orgánica 2/2020, de 29 de diciembre, de Educación por la que se modifica la Ley Orgánica 27/2006, de 3 de mayo, de Educación*. Madrid: Boletín Oficial del Estado. Available at: https://www.boe.es/boe/dias/2020/12/30/pdfs/BOE-A-2020-17264.pdf (Accessed May 5, 2021).

Ministry of the Presidency (2015). *Orden ECD/65/2015, de 21 de enero, por la que se describen las relaciones entre las competencias, los contenidos y los criterios de evaluación de la educación primaria, la educación secundaria obligatoria y el bachillerato*. Madrid: Boletín Oficial del Estado. Available at: https://www.boe.es/boe/dias/2015/01/29/pdfs/BOE-A-2015-738.pdf (Accessed May 5, 2021).

Monti, F., Farné, R., Crudeli, F., Agostini, F., Minelli, M., and Ceciliani, A. (2019). The role of outdoor education in child development in Italian nursery schools. *Early Child. Dev. Care* 189 (6), 867–882. doi:10.1080/03004430.2017.1345896

Morales Agudo, J. (2015). *E-Museum. Una investigación sobre tecnologías para "aprender a aprender" en Educación Plástica y Visual*. Zaragoza: Universidad de Zaragoza ([Ph.D. Thesis.

Morales, A. J., Caurín, C., Sendra, C., and Parra, M. (2014). Aprendiendo a plantear problemas en el medio. Análisis de una experiencia con estudiantes del Máster de Investigación en Didácticas. *Didáctica de las Ciencias Experimentales y Sociales* 28, 68–81. doi:10.7203/dces.28.3848

Morin, E. (1990). *Introduction à la Pensée Complexe*. Paris: ESF.

Morón Monge, M. C., Abril López, D., and Morón Moge, H. (2018). "La educación no formal desde la interpretación del paisaje: el Cabezo de la Almagra (Huelva)," in *Contribución didáctica de al aprendizaje de la geografía*. Editor A. de la Vega (Madrid: UAM/AGE)), 961–976.

Morón-Monge, H., Morón-Monge, M. d. C., Abril-López, D., and Daza Navarro, M. P. (2020). An Approach to Prospective Primary School Teachers' Concept of Environment and Biodiversity through their Design of Educational Itineraries: Validation of an Evaluation Rubric. *Sustainability* 12 (14), 5553. doi:10.3390/su12145553

Munley, M. E. (2012). *Early Learning in Museums. A Review of Literature*. Washington, D.C.: Smithsonian. Available at: https://www.si.edu/Content/SEEC/docs/mem%20literature%20review%20early%20learning%20in%20museums%20final%204%2012%202012.pdf (Accessed April 30, 2021).

Muñoz, A. (2009). El Desarrollo de las Competencias Básicas en Educación Infantil. Alcalá de Guadaíra: MAD-Eduforma.

Muñoz García, G., and Jiménez Pablo, E. (2020). Las competencias sociales en la formación del profesorado de Educación Infantil. Explorando el espacio doméstico para crecer desde la diversidad cultural. *Pulso* 43, 193–211. Available at: https://revistas.cardenalcisneros.es/index.php/PULSO/article/view/390/322 (Accessed July 5, 2021).

Olivares, S. L., López, M. V., and Valdez-García, J. E. (2018). Aprendizaje basado en retos: una experiencia de innovación para enfrentar problemas de salud pública. *Educación Médica* 19 (3), 230–237. doi:10.1016/j.edumed.2017.10.001

Orellana, L., and Andreu, M. (2014). El museo: arte en un espacio proyectado. *AusArt J. Res. Art* 3 (2), 112–125. Available at: https://ojs.ehu.eus/index.php/ausart/article/view/14007/12401 (Accessed May 4, 2021)

Organisation for Economic Co-Operation and Development (OECD) (2020). *PISA 2018 Results (Volume VI): Are Students Ready to Thrive in an Interconnected World?* [pdf]. OECD Publishing: Paris. Available at: https://www.oecd-ilibrary.org/docserver/d5f68679-en.pdf?expires=1618307696&id=id&accname=guest&checksum=0BB7265F0ED2A6B8D432DD456B7D994A (Accessed March 20, 2021).

Organisation For Economic Co-Operation and Development (OECD) (2007). *The Definition and Selection of Key Competences*. Paris: OECD Publishing. Available at: https://www.oecd.org/pisa/35070367.pdf (Accessed March 9, 2021).

Pérez Pérez, C., García García, F. J., Vázquez Verdera, V., García Félix, E., and Riquelme Soto, V. (2020). La competencia "aprender a aprender" en los grados universitarios. *Aula_abierta* 49, 309–323. doi:10.17811/rifie.49.3.2020.309-323

Pérez-Sanagustín, M., Parra, D., Verdugo, R., García-Galleguillos, G., and Nussbaum, M. (2016). Using QR codes to increase user engagement in museum-like spaces. *Comput. Hum. Behav.* 60, 73–85. doi:10.1016/j.chb.2016.02.012

Publications Office of the European Union (2006). Luxembourg City: Official Journal of the European Union. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006H0962&from=EN (Accessed March 14, 2021).Recommendation 2006/962/EC, of 18 December 2006, of the European Parliament and of the Council on key competences, for lifelone learning.

Robin, B. (2006). *The educational uses of digital storytelling*. Houston: University of Houston. Available at: https://digitalliteracyintheclassroom.pbworks.com/f/Educ-Uses-DS.pdf (Accessed May 5, 2021).

Romero Ariza, M. (2010). El aprendizaje experiencial y las nuevas demandas formativas. *Revista de Antropología Exp.* 10 (8), 89–110. Available at: https://revistaselectronicas.ujaen.es/index.php/rae/article/view/1970/1718 (Accessed April 15, 2021).

Sánchez Vera, M. d. M., Solano Fernández, I. M., and Recio Caride, S. (2019). El storytelling digital a través de vídeos en el contexto de la Educación Infantil. *Pixel-Bit* 54, 165–184. doi:10.12795/pixelbit.2019.i54.09Available at: https://recyt.fecyt.es/index.php/pixel/article/view/65102/42104 (Accessed May 3, 2021)

Sanz, J., and Zuzuarregui, A. (2017). *Las salidas en el Grado de Educación infantil: fomentando el sentido crítico de las futuras maestras.* Enseñanza de las Ciencias *núm. extra*, 2225–2230. Available at: https://raco.cat/index.php/Ensenanza/article/view/336841/427638 (Accessed July 4, 2021).

Solís-Espallargas, C., and Morón-Monge, H. (2020). How to improve sustainability competences of teacher training? Inquiring the prior knowledge on climate change in primary school students. *Sustainability* 12, 6486. doi:10.3390/su12166486

Tecnológico de Monterrey (2016). Aprendizaje basado en retos. Monterrey. *Monterrey*. Monterrey, Mexico: Editorial Instituto Tecnológico y de Estudios Superiores de Monterrey. Available at: http://observatorio.itesm.mx/edutrendsabr/ (Accessed April 29, 2021).

Ureña, M. (2013). Competencias y proyectos en Educación Infantil: Hacia una educación holística. *Calanda* 8, 22–31. Available at: https://sede.educacion.gob.es/publiventa/descarga.action?f_codigo_agc=15953 (Accessed March 21, 2021).

Vázquez, S. (2009). TIC y competencia aprender a aprender. *Padres y Madres* 326, 38–39. Available at: https://revistas.comillas.edu/index.php/padresymaestros/article/view/1325/1132 (Accessed April 21, 2021).

Vieites, M. C. (2009). *Programación por Competencias en Educación Infantil. Del Proyecto Educativo al Desarrollo Integral del Alumnado*. Vigo: Ideaspropias Editorial.

Wilson, R. A. (1994). *Environmental Education at the Early Childhood Level*. Washington, D.C.: North American Association for Environmental Education.

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