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Challenges with Complex Situations in the Teaching and Learning of Social Sciences in Initial Teacher Education

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Abstract: This article not only presents a paradigm shift as a methodological model for teaching heritage and social sciences (SSCC), but also offers a methodological foundation for the challenge-based learning (CBL) methodology. We present various educational innovations in social science teaching and cultural heritage education based on the use of CBL during initial teacher training at the University of Andorra. These methodological proposals take into account the TPACK model (Technological Pedagogical Content Knowledge) based on the interrelation of three types of knowledge: pedagogical content knowledge (PCK), technological content knowledge (TCK), and technological pedagogical knowledge (TPK). This set of best practices requires students to respond to a complex social challenge by designing and creating specific educational proposals for tackling content and learning through gamification. Students work on the various dimensions of the SSCC, thereby developing spatial competency, teaching competency, and competency in democratic citizenship. ICTs are included throughout in order to develop students' digital competency. As a result, students feel empowered through having acquired the different competencies and developed an awareness of the value of cultural heritage as a cornerstone of democratic citizenship.

Keywords: higher education; initial teacher training; challenge-based learning (CBL); TPACK (technological pedagogical content knowledge); relevant social problems; cultural heritage education; education for democratic citizenship



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1. Introduction

Universities and higher education institutions, as providers of knowledge, are closely interconnected with societal challenges and are intimately linked to the commitment to help to develop sustainable societies (Leijon et al. 2021). It is essential to promote study plans and educational practices that enable students to face complex situations and become transforming agents. In this sense, the Educational 2030 Framework for Action (FFA) examines the learning outcomes to prepare students to become active citizens. Higher Education is the setting to deliver a fair and sustainable education and social development (Diez et al. 2021).

In the first half of the 20th century, Dewey (1995, 2002) defended teaching based on the real problems of society in the development of reflective thought and in the learning of democratic participation. Dewey defends the thesis that knowledge is built from experience, in a continuous interaction with the environment. Social Science pedagogy should train students to develop critical thinking based on social justice and democracy as pillars of democratic citizenship competence. In an increasingly diverse changing society, wherein concepts are continually questioned, the critical spirit of students must be taught and trained to nurture a critical understanding based on justice, and thus influence the formation of active and committed citizens (Dam and Volman 2004; Diez et al. 2021; Pagès and Santisteban 2011).

This paper presents a line-up of Social Sciences cases of good innovative education practices in Initial Teacher Education at the University of Andorra, conducted with students of the Bachelor of Science in Education through the challenge-based learning (CBL) methodology. Once the challenge is launched, it is worth highlighting the creativity and innovation of the final results as well as the different interconnections established with other subjects, such as mathematics or language.

The main objective is to promote the use and application of technological resources and digital materials, resulting from the integration of applied technologies and cultural heritage, to bring cultural heritage closer to the classroom (Yáñez 2017; Larraz et al. 2014). Students, based on their previous research work, documentation, and analysis of educational materials on the web, design various proposals in order to meet the requirements of the challenge. These proposals usually have a high technological component, and therefore, it is an activity that helps to develop the Teachers' Digital Competence (TDC). These didactic proposals, focused on primary school students, have as a goal bringing cultural heritage into the classroom to not only make it more accessible, but also to learn and acquire knowledge from a new perspective. This type of task requires that the teacher monitors and accompanies the student throughout the whole process to ensure that corrections can be introduced as the task is being designed and developed. It is part of the Learning by Doing methodology that enhances the development of skills to respond to a complex situation and consequently learn from experience (Schank 2002; Yáñez and Gómez-Trigueros 2022). The results show how, from an interdisciplinary approach and a methodology focused on challenge-based learning (CBL), specific and transversal competences can be worked and achieved during initial teacher training.

1.1. Competencies in Higher Education

Globalization has created an increasingly diverse and hyperconnected world. In order to confront the new challenges, individuals must acquire new competencies (understood as skills, attitudes, and values) in order to achieve individual goals and autonomous development, together with collective goals involving the necessary interaction with society (Yáñez and Gómez-Trigueros 2021). In today's information and communication society (ICS), there is a need for education to be reoriented towards innovation, the driving force behind change, and for teachers to act as agents of change.

Various European and international organizations, such as the European Commission (2022) and the OECD (2005), have reflected on the social, economic, and cultural transformations of the twenty-first century and have stressed the need to anticipate new demands given the ever-changing context, the impact of globalization, and the complex socio-cultural and economic relations that result from it. The traditional teaching model is being replaced by the learning environment model, based on real contexts, the use of new tools, and negotiation amongst peers around the meaning of knowledge (Basque et al. 2000).

1.2. Bachelor's Degree in Teaching and Learning (BCE) at the University of Andorra (UdA): A Competency-Based University Education Model

The English term 'dual' and the French term 'en alternance' both refer to a model of training that enables the student to combine academic and professional activity, with knowledge acquired in both the academic and professional fields. University tutors and school mentors are jointly responsible for the training and assessment of the activities carried out by the student in shared tutorials (Latorre et al. 2020; Pla 2015).

Dual training was implemented in the Bachelor's degree in Teaching and Learning (BCE) between 2014–2015 and 2018–2019. The teaching–learning (T-L) approach includes students attending theoretical classes at the university three days a week and undertaking work experience in primary schools two days a week. This T-L model enables students to learn about the theory of different subjects and to complement it with teaching practice. Students are thus better able to integrate theoretical and practical knowledge and develop competencies in a professional environment (Monné 2017).

In 2018, in response to a changing, competency-based society, the University of Andorra (UdA), the only public university in the Principality of Andorra, decided to launch a new educational model focused on competency-based learning and assessment, with competency being defined as ‘an action or intervention in which a set of content (facts and concepts, procedures, attitudes and values) is incorporated and employed by the student in order to successfully respond to professional challenges’ (Larraz et al. 2020, p. 2; Perrenoud 2004). The model is based on the development and assessment of both specific and cross-disciplinary competencies focused on multilingualism, democratic culture, and the values of the Sustainable Development Goals (SDGs).

The current curriculum of the BCE complies with the new educational model of the University of Andorra, with a competency-based methodology that eliminates the boundaries between individual subjects. Each semester is divided into two modules, in which students must overcome a complex challenge by means of guided work, individual work, and seminars. Each challenge is associated with learning outcomes that are derived from the specific and cross-disciplinary competencies of the degree (Saz et al. 2020).

Competency-based work benefits from low student–teacher ratios, which makes it possible for students to be closely monitored. These educational innovations focus on the importance of heritage education and dissemination, a 360° experience in which educational and cultural institutions work to safeguard and conserve heritage.

2. Theoretical Foundations

2.1. The New Learning Environments

Pujolàs (2003) has argued that education is experiencing a paradigm shift with the advent of what has been called twenty-first-century education (Peñalba and Leiva 2019), the aim of which is to provide the resources and tools to share knowledge. It is therefore necessary to generate new learning contexts or spaces that encourage the traditional top-down system to evolve into one that enhances the application of knowledge and focuses on competency-based learning (Monné and Yáñez 2019).

Society is constantly changing, and the learning opportunities that arise must be seized. Schools must extend beyond the curriculum and leave the classroom to deliver more comprehensive, experiential learning, taking advantage of the opportunities offered by the immediate environment. It is therefore no longer only a question of teaching students, but of teaching them to develop reliable tools, to give them a compass to find their own way in an increasingly complex, volatile, and uncertain world (OECD 2019).

The aim of the so-called 360° education is to provide cross-disciplinary teaching beyond the school walls, taking advantage of the opportunities and possibilities offered by the environment and the territory as settings for different kinds of learning, understanding territory as the geographic element (physical and human), in which the human being is contextualized. It provides a broader view by expanding the time and spaces for learning. It views the territory, the community, and cooperation with different cultural agents as an educational ecosystem full of opportunities for learning, for connecting formal and non-formal, school and non-school learning. A holistic education with fluid boundaries between formal and non-formal learning should provide a better response to a complex, uncertain society characterized by various economic, social, cultural, and technological changes. These interconnected structures of knowledge require not only competency-based learning, but also interdisciplinary work.

Gangopadhyay (2014) has explained how museums, and cultural centers in general, can help to generate rapid innovations and changes in education and learning. The author focuses on new learning settings and experiences through the application of three central strategies, involving proactive, relevant, and innovative practices (Yáñez et al. 2015).

Camacho (2018, p. 22) suggests that educational innovation should be understood as ‘a dynamic process of vision, change, and creation, which requires energy and passion in order to create and implement new ideas’. In line with this approach, the various teaching innovations we present are based on the following foundations:

1. CBL (challenge-based learning);
2. Critical and reflective decision making;
3. Interdisciplinarity;
4. Cooperative work and autonomy in learning;
5. Democratic citizenship and human rights.

2.2. Challenge-Based Learning (CBL)

CBL is a learning opportunity in which students, guided by the teacher, collaborate to solve real and relevant challenges, in a context outside the classroom. The exhaustive bibliographic review carried out by [Leijon et al. \(2021, p. 3\)](#) establishes that the challenge-based learning (CBL) methodology “connects to entrepreneurial learning as well as self-regulated learning, organisational double-loop learning, and authentic learning”. To sum up, we can trace theories of learning stemming from cognitive, but also constructive and socio-cultural perspectives, wherein learning is active, relational, practical, and situated within both the individual and the organisation ([Argyris and Schön 1978](#); [Kolb 1984](#); [Lave and Wenger 1991](#)). It facilitates the acquisition of basic skills in the Social Sciences, allowing to work and connect with real-world scenarios and facilitates as well the development of entrepreneurship and critical thinking, forming active and committed citizens.

Teaching based on this strategy aims to focus on activities that pose problematic situations whose resolution requires analysing, discovering, developing hypotheses, confronting, reflecting, arguing and communicating ideas to achieve student learning.

“This didactic methodology reviews the T-L methods to determine the best practices to produce learning environments to develop and foster creativity. The results observed in the students are: critical and divergent thinking, new ideas and innovative solutions to problems”.

([Olivares et al. 2018](#), p. 232, based on [Fletcher 2011](#))

This approach encourages working in projects or integrated tasks ([Edu Trends 2016](#); [Gaskins et al. 2015](#); [Pérez-Sánchez et al. 2020](#)). This is a didactic guarantee for an effective contribution to the development of key competences, as well as to the meaningful learning of curricular content. This methodology involves different actions to be followed: analyse; diagnose; observe; investigate; devise; decide; design; analyse the feasibility, sustainability and impact on the environment; implement; and evaluate.

Hence, this process fosters the students’ acquisition of Social Sciences’ basic skills. They allow to work and connect with real-world scenarios and also facilitates the development of entrepreneurship and critical thinking, forming active and committed citizens. Through CBL, students develop the following competencies: ability to research, analyse, and manage information; decision making to solve a complex problem; critical thinking innovation and creativity; ability to argue and reason effectively; collaborative learning; teamwork; development of democratic attitudes and values; ability to transmit to communicate; and ICT integration.

2.3. The TPACK Model

One T-L model that focuses on the correct use of technologies in the classroom is the Technological Pedagogical Content Knowledge (TPACK) model. This model suggests that teachers need to acquire pedagogical knowledge (PK), content knowledge (CK), and technological knowledge (TK) ([Mishra and Koehler 2006, 2007](#)). Furthermore, it stresses the importance of the interaction of these three elements (CK, PK, and TK) in the T-L process. The resulting network of interrelations must be understood and mobilized by teachers in order to correctly integrate ICTs in their daily activity. According to this model, teachers do not use these areas of knowledge in isolation; rather, by working with them in an interrelated way, they develop new kinds of knowledge, namely:

- *Pedagogical Content Knowledge*, or PCK, which refers to the different pedagogical skills that a teacher can employ to teach a specific discipline (or content), adapting to the available resources and the diversity of students in the classroom.
- *Technological Content Knowledge*, or TCK, which is related to the mastery of disciplinary knowledge about the subject to be taught and the ability to discern the specific technologies that will enable students to learn.
- *Technological Pedagogical Knowledge*, or TPK, which refers to the teacher's understanding of the effect of ICT tools on their students' learning process. The teacher should discern when and how to use such resources to enable students to acquire knowledge.

The TPACK model takes on board the fact that technology is here to stay. Faced with this reality, teachers must be trained in the use of technologies and acquire the skills to adapt to the changes introduced by new software and hardware.

Moreover, the TPACK model provides a new perspective on incorporating ICTs in the classroom, focusing not only on instrumental competencies but also on their interrelation with the didactic component (Gómez-Trigueros and Yáñez 2021). Educational institutions must ensure that teachers are trained in the various competencies, including teacher digital competency (TDC). Such mastery and understanding should enable them to use technology correctly in their teaching (Gómez-Trigueros et al. 2019; Gómez-Trigueros and Yáñez 2021). Similarly, the TPACK model resolves issues in initial teacher training, helping trainee teachers to develop their methodology in the use of ICTs for teaching. The model encourages trainee teachers to make use of reflective practice: it prompts a reflection on their training; helps them to develop greater self-knowledge and improve their teaching practice; enables a better understanding of how to use technological tools in education (Gómez-Trigueros and Yáñez 2021); and encourages them to focus on enabling their students to learn in a meaningful way, and not on whether or not to use technological resources in the classroom.

2.4. Cultural Heritage Education Is Essential for Democratic Citizenship and the Construction of Historical Memory

Cultural heritage education enables individuals to learn about and relate to the past in order to understand the present, while also acquiring ideas about space and time that are essential for the construction of a critical spirit. It also helps students to develop empathy, solidarity, cooperation, and respect for other cultures (Estepa et al. 2005). In order to promote not only knowledge but also the active participation of individuals in the different cultural expressions in their environment, it is essential to develop strategies to encourage students to become interested in and develop respect for heritage. This should contribute to the development of more plural and democratic societies (Morote and Colomer 2021; Yáñez and Gómez-Trigueros 2022).

One of the strategies for combatting the population's lack of interest in cultural heritage is to actively promote the teaching of heritage in schools, specifically in the field of citizenship education. Heritage should be studied not only as a resource, but also as conceptual, procedural, and attitudinal content (Yáñez 2017). As we can see on Figure 1, the objective is to raise awareness of the importance of preserving heritage for future generations and to encourage students to appreciate it and to become actively involved in its conservation and dissemination (Casanova et al. 2018; Cuenca and Martín 2014; Cuenca and Pérez 2021).



Figure 1. Steps to raise awareness about heritage. Own source.

3. Objectives

The main objective is to present a series of best practices, understood as educational resources designed to introduce primary school pupils to heritage, history, and, ultimately, the Social Sciences.

In response to the different challenges set, students had to acquire the knowledge and skills related to the different subjects and design educational resources that in some cases had an important digital component.

In addition to involving teaching and learning through formative and evaluative methodologies, the practices presented consider four dimensions of the Social Sciences: time, space, art/culture, and democratic citizenship. They also had to promote active learning with a strong creative component and encourage the use of technologies in the classroom.

This general objective was split into the following specific objectives:

- Promote teaching innovation and good practices in heritage education.
- Increase Spatial Competence (SC) (time and space) in future trainee teachers.
- To increase the Digital Competence (DC) of future teachers in the applied use of ICT through the CBL (challenge-based learning) methodology.
- Enhance Democratic Citizenship Competence (DCC) and Sustainable Development Goals (SDGs).
- To foster the competences of enquiry, critical thinking, and autonomous work as well as the ability to work in groups.
- To promote the interconnection between education and culture.

4. Methodology

These teaching innovations were based on challenge-based learning (CBL), an approach that involves students playing an active role in their learning, in line with the constructivist model and principles defined by [Savery \(2015\)](#):

- Introduce the project and motivate students to respond to an educational challenge.
- Inform students about the competencies to be developed and the learning expectations.
- Organize work teams, plan the tasks, and agree on a schedule.
- Mentor and guide students' work.
- Students present and justify their responses.
- Students reflect and evaluate together, encouraging self-assessment, peer assessment, and teacher assessment.

4.1. Participants and Context

These different CBL-based teaching innovations involved trainee teachers (of children aged 0–12 years) in their second and third year of the Bachelor's degree in Teaching and Learning at the University of Andorra. A total of 101 second-year students undertaking the course in 'Education in the Cultural Heritage of Andorra' and 92 third-year students taking 'Social Science Didactics' followed this curriculum during the study (Table 1).

Both courses followed the 2015 dual curriculum, which involved project-based work clearly designed to develop competencies. Given the experience acquired in CBL and the fact that the new T-L educational model was based on responding to challenges, the aim was to transfer the experience acquired through this set of experiences to the new educational model of the Bachelor's degree.

The content of the new model was delivered in two seminars (which had the same name as the courses), which formed part of the module on the basic principles and content of the Social Sciences. This module provided tools for social science teaching and encouraged social and critical thinking, along with democratic principles and culture. The main objective of SSCC teaching is to provide students with the knowledge, skills, and competencies necessary to become active and informed citizens, capable of thinking

critically, understanding and explaining the perspectives of others, making judgments, and communicating effectively.

Table 1. Total number of students participating in these educational experiences. Own source.

Academic year	Courses	
	Education in the Cultural Heritage of Andorra second-year students	Social Sciences Didactics third-year students
2014–2015	21	13
2015–2016	22	19
2016–2017	22	13
2017–2018	13	21
2018–2019	15	11
2019–2020	1	14
2020–2021	7	1
TOTAL	101	92

4.2. Design of the Challenge

The challenges were complex, real situations that may present more than one possible response. They should be close to reality, arouse the student's interest and motivation, and incorporate different disciplines. They should also encourage critical thinking so that students can make reasoned decisions, based on evidence and facts, and determine the necessary resources for the proposed response and the strategies to be used for assessment.

The challenges start with the formulation of a key question, with a distinction between the nature and the purpose of the challenge (Table 2).

Table 2. Approach to the formulation of key questions. Source adapted from Lattimer (2008).

What Are They?	What Are They for?
They help to arrive to the focus of the discipline. They pose dilemmas that overturn established truths or canons.	They allow one to construct one's own understanding of the past
They can have more than one answer.	Show that history is a developmental narrative.
Connect past with present.	Challenge to analyze and examine one's own beliefs.
Must: be open-ended; be provocative; require a high order of reasoning; lead to reasoning rather than repetition or memorization; can be revisited and generate new questions and concerns; generate debate; require evidence.	Prepare students for civic participation in a democratic society.

Most of the T-L innovations we present focus on cultural heritage and the cultural landscape (the context of time and space), which have a powerful transformative capacity. Transformative heritage sites 'empower the visitor to transform their environment through educational activities that are designed to encourage permanent dialogue between action (doing), reflection (thinking), conversation (communicating), and emotion (feeling)' (CoP 2018, p. 5). This makes it necessary to ask the following questions:

1. What do we want to teach? In order to provide interpretation models, there should be dialogue between doing, thinking, and communicating.
2. How do we want to teach it? Teaching should encourage observation, analysis, and reflection, as well as innovation to encourage dialogue.

3. Where should we teach it? The setting where the T-L process takes place is fundamental. The contexts must be real, complex, stimulating, and, above all, challenging spaces.
4. Who do we want to teach and why? Teachers must be builders of knowledge and authentic agents of transformation.

In order to work on complex situations, a challenge must have the following characteristics.

- Be real, truthful, with some social, vocational, and personal relevance.
- Generate a meaningful learning situation.
- Allow the contents to be worked on in limited contexts, preferably in the environment if possible.
- Raise guiding questions.
- To produce a cognitive conflict, a need to know.
- Provoke critical thinking and move away from rote or repetitive tasks.
- Be assumable, with a gradual complexity, with the consequent planning and hierarchization of tasks that favor autonomy as well as interaction with heterogeneous groups.
- Generate a certain degree of uncertainty, as a result of the gradual process of learning by doing, which involves not knowing what the final result will be.
- Encourage work by competences.
- Encourage interdisciplinary work.
- Encourage meaningful learning.
- Encourage interrelation between doing (experimenting), thinking (knowledge structure), and communicating (expressing and disseminating in different formats).
- Evaluate and reformulate the context. How to work with the same concepts in different contexts. What changes?
- Ensuring the transfer of knowledge to the real environment.

CBL methodology can be broken down in order to establish the phases of the process, which are shown in the following Table 3 and in Figure 2.

Table 3. CBL methodology. Own Source.

CBL Process	Guidance
<p>1. Starting point</p> <ul style="list-style-type: none"> • Defining the challenge; • Brainstorming; • Activate prior knowledge. 	<p>Explaining the challenge in detail.</p>
<p>2. Analysis and research</p> <ul style="list-style-type: none"> • Documentation and research on the issue, the theme and the different stakeholders involved. What do we know? What primary or secondary sources do we have? Who is our audience? • Consider multiple accounts and perspectives; • Analyse primary sources; • Consider context; • Claim–evidence connection; • Identify the compelling and essential questions; • Define the problem and goals; • Foresee the main desirable learning outcomes. 	<p>Independent learning; Time to do research and to internalize the problem; Teamwork to share points of view and strategies; Collective mentoring sessions to review the initial approaches.</p>
<p>3. Planning</p> <ul style="list-style-type: none"> • Planning and organizing the different tasks; • Organize ideas; • Distribute roles. • Timeline. Sequence of actions and tasks. 	<p>Individual mentoring sessions; Individual and teamwork.</p>

Table 3. Cont.

CBL Process	Guidance
4. Creativity <ul style="list-style-type: none"> Design of manual and digital educational activities as a response to the challenge. 	Individual mentoring sessions Individual and teamwork.
5. Simulation <ul style="list-style-type: none"> Intermediate defense; Amend and correct errors. 	Feedback from: Peer intermediate assessment Teacher’s assessment
6. Innovation <ul style="list-style-type: none"> Apply knowledge; Develop activities; Use ICT tools to encourage interactions. 	Individual and teamwork.
7. Implement <ul style="list-style-type: none"> Expose the proposal for assessment and peer evaluation; Implement in a real scenario; Validate at the chosen scenario. Check the effectiveness of the implemented solution. 	Individual work.
8. Defense <ul style="list-style-type: none"> Expose the given answer to the challenge; Gather suggestions for improvement. 	Individual work.
9. Assessment <ul style="list-style-type: none"> Evaluate and amend if necessary; Measure learning outcomes. 	Individual work.

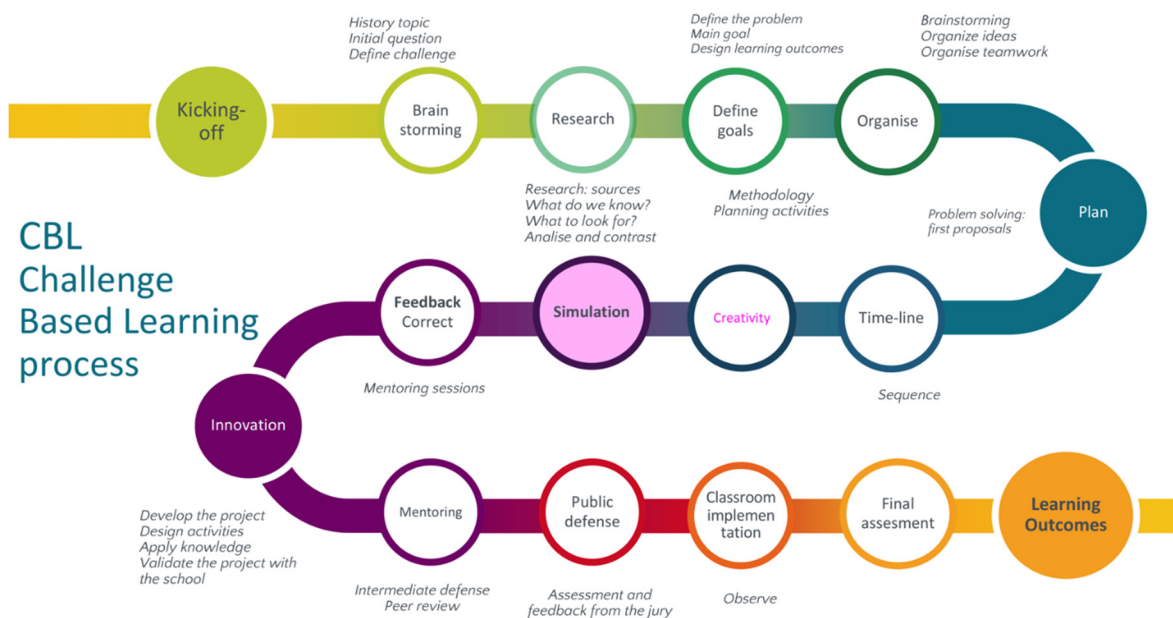


Figure 2. CBL methodology process. Own source.

4.3. The Role of the Teacher

The teacher uses questions to challenge students’ knowledge and stimulate cognitive processes that promote critical thinking. By avoiding leading questions, the interaction takes place at a metacognitive level.

In his discussion of the tutorial process, as Barrows states from Savery and Duffy (1995, p. 11): ‘The ability of the tutor to use enabling teaching skills during the small group learning

process is the major determinant of the quality and the success of any educational method aimed at (1) developing students' thinking or reasoning skills (problem solving, metacognition, critical thinking) as they learn, and (2) helping them to become independent, self-directed learners (learning to learn, learning management). Tutoring is a teaching skill central to problem-based, self-directed learning' (Barrows 1992, p. 12).

5. Results

Cognitive as well as emotional, cultural, and social aspects operate in this multidimensional process. This process has led to the replacement of the traditional way in solving mechanized problems, by a new methodology to solve real, interdisciplinary, professional problems that allow to find multiple solutions (Couso et al. 2008; Pérez and Chamizo 2011).

5.1. Map of Educational Innovations

The overall objective of the activities presented was to promote the knowledge of and respect for cultural heritage as well as to generate an emotional bond with heritage that would ensure that today's trainee teachers would be true agents of transformation as active teachers in the future.

The different teaching innovations were divided into a series of categories based on the type of activity (see Table 4).

Table 4. Categories of the group activities developed. Own source.

A.	Transfer to society: activities in collaboration with social agents (schools, town councils, museums, etc.).
B.	Experiences of teaching innovation in the classroom: manipulative activities to promote creativity, enquiry and emotional education (hands-on and heart-on).
C.	Heritage education and LKT interdisciplinary activities between the subjects of Heritage Education and LKT and to promote Geographical Information Technologies (GIT).
D.	Gamification: activities to promote interest in heritage, where the basis is enquiry and play.
E.	Sensorial workshops in Cultural Heritage Education: multisensory activities to promote interest in heritage.
F.	Cultural heritage in situ: field trips to be able to know, explore, and understand how heritage is managed.
G.	Democratic citizenship and human rights: from the analysis of a historical event, activities are designed to promote the competence of democratic citizenship as well as the values of human rights.
H.	Space–Time–Heritage: activities focused on working on spatial competence.

Similarly, the innovations are associated with different dimensions of the Social Sciences: history, geography, art, heritage, and democratic citizenship. History and geography are two fundamental pillars of the SSCC, since they enable learners to develop an understanding of space and time, while offering a broad vision of the world and of society.

The following table (see Table 5) shows the map of best practices in educational innovation, grouped according to category and associated with the different Social Science dimensions. They are all interrelated and encourage meaningful and relevant learning.

Table 5. Map of teaching innovation experiences in the area of cultural heritage and Social Sciences and dimensions. Own source.

Category	Experiences of Teaching Innovation	Dimension				
		History	Geography	Art	Heritage	Democratic citizenship
A. Transfer to society	Paint me a story at the Andorran Primary School (Ordino)	x	x	x	x	x
	Story: "The Stefanoni brothers"	x	x	x	x	x
	Personal heritage and generational exchange: Aula Magna				x	x
	Workshops at the Casa de la Vall. Consell General (parliament)	x			x	x
	#Museu Carmen Thyssen Andorra Challenge			x	x	
	Training of trainers: workshops in schools					x
B. Teaching innovation in the classroom	What have we learnt? One minute paper	x	x	x	x	x
	Life stories: the heritage object	x	x	x	x	x
	Museum in a box			x	x	
	Mystery box	x	x		x	
	Basket Beat: emotional education					x
C. Education in Heritage and LKT	Let's reinvent the story: "Meninas' project" & "American Gothic"			x		
	EQuadem and Andorra's heritage			x		
D. Gamification	Google Earth Pro™ and the discovery of cultural and natural heritage	x	x	x	x	x
	Wix of the Romanesque of Andorra	x	x	x	x	x
	"Pass the word": history and heritage				x	
	Smart Art Lab: Art and technology	x	x	x	x	x
E. Sensorial workshops in Cultural Heritage Education	Suitcase <i>Escape Room</i> to discover heritage	x	x	x	x	x
	Cultural heritage workshops				x	x
F. Cultural Heritage in situ	Design workshops for different museums				x	x
	Visit, analysis, and workshops in different museum facilities (archaeological sites, Electricity Museum, CAEE, Casa de la Vall, Carmen Thyssen Andorra Museum, Tobacco Museum, mapping of the Church of Santa Coloma, etc).	x	x	x	x	x
	The cultural heritage from the 7 parishes	x	x	x	x	x
G. Democratic citizenship and Human Rights	Visit to temporary exhibitions: "The 1982 floods".	x				x
	<i>Citizens of the world</i>	x	x	x	x	x
H. Space-Time, Heritage	Life story. Testimony of Norman Westby, RAF (British Armed Forces) pilot in the Second World War	x	x			x
	Timelines	x	x			
TOTAL of dimensions distributed among activities	Mental maps, the geographical center, and spatial competition		x		x	
		15	14	14	19	18

The Social Science dimensions are fairly well distributed among all the activities. The focus is primarily on heritage, with 19 of the 27 activities (70.37%), followed by democratic citizenship, with 18 of the 27 activities (66.66%). A total of 55.55% worked on history, and 51.85% worked on geography and art.

Of the 27 activities, the following Table 6 shows the distribution of the activities referred to in Table 5 divided into categories. The first two, which include activities both in and outside the classroom, have the greatest weight.

Table 6. Distribution of activities by categories. Own source.

Categories and Activities							
A.	B.	C.	D.	E.	F.	G.	H.
22.2%	22.2%	7.40%	14.80%	7.40%	11.10%	7.40%	7.40%

5.2. Educational Innovations in the Social Sciences and Heritage Education and the TPACK Model

The following table (see Table 7) associates best teaching practices with the categories in the KBT (Knowledge Base for Teachers) (Shulman 1986) and TPACK models (Mishra and Koehler 2006). The following elements are verified in the KBT model: (a) content knowledge (CK), which refers to the necessary (and acceptable) content on the subject to be taught in the classroom, along with the (scientific, philosophical, and historical) resources available in which to search for further knowledge, i.e., the teacher's awareness of the bibliography on the subject they are teaching; and (b) pedagogical knowledge (PK), which refers to the training in strategies, methodologies, and pedagogy that the teacher employs to make the subject (scientific content) understandable to their pupils. This can be described as the 'wisdom of practice' (Shulman 1986, p. 15). This foundation of the KBT relates to the good teaching practice developed by teachers in the classroom, which is learnt by experience and by observing other teachers. This 'source' is the perfect combination of teachers' knowledge and its application to enable pupils to acquire, understand, and learn such knowledge.

Table 7. Association of the activities to the model: KBT (Knowledge Base For Teachers); PCK (Pedagogical Content Knowledge); TCK (Technological Disciplinary Knowledge); and TPK (Technological Pedagogical Content).

Category	Experiences of Teaching Innovation	KBT			TPACK Model		
		CK	PK	KBT (CK + PK)	PCK	TCK	TPK
A.	Paint me a story at the Andorran Primary School (Ordino)	x	x	x			
	Story: "The Stefanoni brothers"	x	x	x			
	Personal heritage and generational exchange: Aula Magna	x	x	x			
	Workshops at the Casa de la Vall. Consell General (parliament)	x	x	x			
	#Museu Carmen Thyssen Andorra Challenge				x	x	x
	Training of trainers: workshops in schools				x	x	x
B.	What have we learnt? One minute paper	x	x	x			
	Life stories: the heritage object	x	x	x			
	Museum in a box	x	x	x			
	Mystery box				x	x	x
	Basket Beat: emotional education	x	x	x			
	Let's reinvent the story: "Meninas' project" & "American Gothic"	x	x	x			
C.	EQuadern and Andorra's heritage				x	x	x
	Google Earth Pro™ and the discovery of cultural and natural heritage				x	x	x
D.	Wix of the Romanesque of Andorra				x	x	x
	"Pass the word": history and heritage	x	x	x			
	Smart Art Lab: Art and technology				x	x	x
	Suitcase Escape Room to discover heritage	x	x	x			

Table 7. Cont.

Category	Experiences of Teaching Innovation	KBT			TPACK Model		
		CK	PK	KBT (CK + PK)	PCK	TCK	TPK
E.	Cultural heritage workshops	x	x	x			
	Design workshops for different museums	x	x	x			
F.	Visit, analysis, and workshops in different museum facilities (archaeological sites, Electricity Museum, CAEE, Casa de la Vall, Carmen Thyssen Andorra Museum, Tobacco Museum, mapping of the Church of Santa Coloma, etc).	x	x	x			
	The cultural heritage from the 7 parishes	x	x	x			
	Visit to temporary exhibitions: "The 1982 floods".	x	x	x			
G.	<i>Citizens of the world</i>				x	x	x
	Life story. Testimony of Norman Westby, RAF (British Armed Forces) pilot in the Second World War	x	x	x			
H.	Timelines				x	x	x
	Mental maps, the geographical center, and spatial competition	x	x	x			

As indicated in Section 2.3 of this article, the different dimensions of the TPACK model are all valued similarly.

Of the 27 teaching innovations, 18 (66.6%) corresponded to the KBT model (Shulman 1986) and the remaining 9 (33.3%) to the TPACK model (Mishra and Koehler 2006).

5.3. Spatial, Digital, and Democratic Citizenship Competence in Some Experiences

The following describes a content summary of some of the implemented teaching innovative experiences that gather all SSCC dimensions, as well as a high Knowledge Learning and Knowledge Technologies (LKT) and Information and Communication Technologies (ICT) component (Table 8).

Table 8. Summary of some of the teaching innovative experiences. Own source.





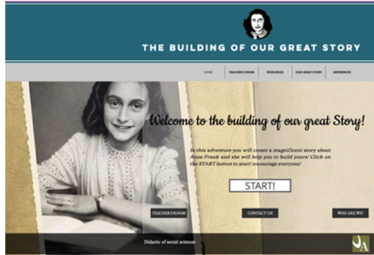

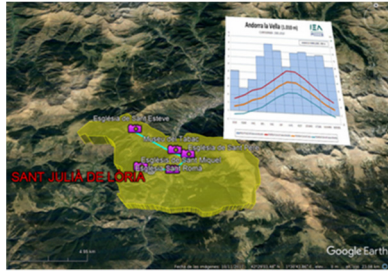

Teaching Innovative Experiences with a LKT and ICT Component	
Web Address Content	Content Description
<p>The Romanesque Wix</p>  <p>https://bit.ly/3ycqeah (accessed on 1 May 2022)</p>	<p>Group project of 2nd year ECB students to create an online platform with activities and strategies for teaching and learning about the country's Romanesque cultural heritage. Use a digital editing platform to place all created material that will become the workspace of teachers and students. The group class was divided into three, each for a stage of primary education. A fourth group was in charge of designing the platform and uploading all the activities created by the other groups. It is evaluated according to: (a) the architecture of the information; (b) the communication strategy; and (c) the viability of the project. It ended up becoming a platform available to all teachers in the country and can be found on the university's website.</p>
<p>E-Notebook</p>  <p>https://bit.ly/3KcNqFT (accessed on 1 May 2022)</p>	<p>Interdisciplinary experience between two subjects: LKT and Education in the cultural heritage of Andorra. Design and creation of a digital material corresponding to a teaching unit of Primary Education in the curricular field of the cultural heritage of Andorra. The final product to be obtained consists of a space in the network where the students of a certain level will find the set of materials and different learning tools corresponding to a didactic unit. Mentoring and evaluation are shared and agreed by both teachers responsible for the subjects.</p>

Table 8. Cont.

Teaching Innovative Experiences with a LKT and ICT Component	
Web Address Content	Content Description
<p>Smart Art Lab</p>  <p></p> <p>https://bit.ly/3s74atO (accessed on 1 May 2022)</p>	<p>Design a Digital Art Lab on a specific artist. The aim is to bring art and history closer to primary school classrooms. Designing manipulative playful pedagogical activities as well as digital activities to foster knowledge, from an innovative and creative point of view, and nurture a taste for art. Use a digital editing platform as a workspace of teachers and students. Bilingual: English and Catalan.</p>
<p>Citizens of the world</p>  <p></p> <p>https://bit.ly/38Uswz8 (accessed on 1 May 2022)</p>	<p>Design a lesson for 6th grade students to promote social understanding of historical facts and human societies and to promote the civic competence necessary for a democratic citizenship. Fosters inquiry by scaffolding curiosity. Learning requires to examine events in history and examples of human behavior. Design a digital editing platform to upload all the designed pedagogical activities, to become a workspace for teachers and students. It is not only about research and understanding the facts, but about emotional engagement and ethical reflection.</p>
<p>Google Earth Pro™</p>  <p></p> <p>https://bit.ly/3LN42aS (accessed on 1 May 2022)</p>	<p>International collaborative e-learning experience between the University of Andorra and the University of Alicante, for teachers in training in the subject of Social Sciences, in the context of the 2020 lockdown. The main goal has been to use a GIT resource as an interdisciplinary strategy to bring cultural and natural heritage closer to Primary Education classrooms. An inter-university online teaching collaboration with a team learning environment</p>

5.4. Assessment and Learning Outcomes

All the teaching innovations presented employed formative assessment to determine students' level of understanding and competency in order to plan the T-L process. The objective of the formative assessment is to guide students to achieve their objectives, so all stages of the learning process have to be assessed. Continuous assessment provides the teacher with information on the state of the T-L and allows modifications to be made in order to adapt teaching strategies so that students achieve mastery of the desired competencies. 'Students gain clear insights into how they are learning and what they can do to improve performance' (Myers 2004, p. 292).

The main objective of the assessments is to foster students' desire to learn, emphasizing autonomy and development, as well as the fundamental role of the teacher in providing continuous feedback on the work throughout the assignment. Examples of formative assessments include rubrics, games, individual and group class dynamics, projects, and presentations.

All the activities involved adapting means of assessment to the project. In the experiences involving a final product, a series of categories were established that grouped indicators based on the learning outcomes and the levels of acquisition of the competencies assigned to each project. Below, we present the categories and indicators that should be taken into account when assessing the design of educational materials in the SSCC that require a technological component (Table 9).

Table 9. Proposal of categories and indicators for the evaluation of Social Science educational materials with a technological component. Own source.

	Assessment Indicators
Architecture information	Content: coherent structure
	Presentation and design
	Variety of materials, images, photography, websites, and web resources
	Introduction and justification
	Main pedagogical and specific goals
	Methodologies
Evidences	Activities to be developed linked to goals, methodologies, and expected learning outcomes
	Primary and secondary sources, Bibliographical sources and citations
Communication strategy	Speech reflection
	Oral and written communication
Feasibility	Feasibility of activities to work heritage
	Usability and accessibility
	Activities adapted to the cognitive level
Digital competence	Mechanical skills in the use of different digital and technological tools
	Didactic skills in the use of different digital and technological tools

6. Discussion

Regarding possible future lines of research that may arise from this study and the compendium of experiences, it is planned to continue this research on the competencies acquired through a CBL methodology, especially over the coming years, which will allow us to have a reading to analyze whether there is a change in the learning outcomes. Without neglecting knowledge, we think it is necessary to introduce active methodologies that allow the approaching, teaching, and learning of heritage, culture, and history in a playful and experiential way. The ideal scenario to internalize learning about heritage is field trips to see it and enjoy it in situ, but this is not always possible. That is why we must bring the heritage sites into the classroom and activate them and revive them in different possible ways through the possible multiple methodologies to create a true “heritage laboratory” in the classroom. Finally, and whenever possible, it should be with a gamification component to make it more attractive, but without losing sight of the rigor of the teaching and learning objectives. Teachers in training should experience heritage not only to know it, but to understand and experience it and become ambassadors of heritage.

This work showed, in a detailed and surgically analyzed step by step way, how to transfer the CBL and TPACK methodology to teaching activities that promote knowledge and respect for cultural heritage as well as generate an emotional bond with it in order to ensure that the trainee teacher becomes a true agent of transformation as an active teacher. The different methodologies that are hidden behind the activities, not only guarantee working the different dimensions of the SSCC, together with the bases of the TPACK model, but also this conjunction of pedagogy, knowledge, and pedagogical and technical knowledge of the methodology ensure the acquisition of KBT in future teachers.

Other works that have preceded ours confirm the need for this type of study and, above all, to be able to incorporate these methodologies in the classroom, for which it is essential that future teachers receive the best possible training (Cuenca 2013; Estepa et al.

2005; Fontal et al. 2012; Fontal and Ibáñez 2017; López-Fernández et al. 2021; Moreno-Vera et al. 2022; Morote and Colomer 2021; Yáñez et al. 2022; Yáñez and Gómez-Trigueros 2021, 2022). In this sense, it is essential to introduce an aspect that, despite not being the specific object of this article, is closely linked and is therefore undeniable. We refer to the need for all these types of activities to introduce the necessary tools to reduce the bias in the digital gender gap (Gómez-Trigueros and Yáñez 2021). There is still a pending issue in empowering women teachers in relation to technology, and we must work to make them role models for their students.

7. Conclusions

At the first International Forum on Education and Technology (FIET), possible future trends and challenges related to the role of technologies in connecting formal and non-formal learning were analysed. Some of the main discussions at the forum revolved around how to use digital technologies and how to enhance digital inclusion, digital culture, and the democratization of culture. The following recommendations emerged from the debate (Yáñez et al. 2015): (a) ensuring accessibility and connectivity worldwide; (b) promoting research on open content, data, and practices; (c) developing learning strategies to address formal and informal education, viewing the environment as an extraordinary and irreplaceable learning setting; and (d) accelerating the digitalization of culture in order to ensure access for a larger number of people.

Trainee teachers, therefore, need to develop their skills to design, assess, and present innovative T-L proposals that meet the demands of twenty-first-century schools (Monné and Yáñez 2019).

The proposals we present in this paper provide a response to these specific objectives. All of them promote awareness of heritage education by means of different strategies, and all of them are the final result of a product associated with a didactic unit. All the activities employ a process of inquiry and analysis of evidence offered by different sources, which encourages spatial competency and critical thinking. Emphasis is placed on the need for inquiry processes that allow the construction of evidence-based arguments, thus encouraging critical thinking and competency in democratic citizenship. Finally, all of them promote collaboration with different social agents, especially schools, where on many occasions it was possible to conduct a pilot during the work experience.

A large number of the activities have an important technological component. This type of educational practice initially generates a certain unease amongst students. The CBL and learning by doing methodology involves students starting from the same point, but each individual's process of inquiry, the decisions they take, and the strategies they adopt lead them to arrive at different final products, creative responses to the same challenge. The key is in the tutoring by the teacher, who must support the student at the different crossroads that arise. When students share their results in the classroom, they feel empowered and proud of their creations, especially when, as trainee teachers, they are able to carry them out in primary classrooms.

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