

WORKING WITH VIRTUAL AND MIXED REALITY IN SECONDARY SCHOOLS

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Abstract

The core requirement for integrating emerging technologies into the classroom is that teachers must understand them and be capable of incorporating them into their classroom methods. In this paper, we present the initial findings of an R&D/Innovation project entitled "Design, implementation and evaluation of mixed reality materials for learning environments" (PID2019-108933GB-I00), showing the teachers' beliefs surrounding this technology and how it relates to their classroom methods and students.

Keywords: *Virtual Reality, Mixed Reality, Secondary Schools, Key Competences, Classroom Methodology*

1. INTRODUCTION

In line with the demands of 21st century society, education today requires methodological reforms in accordance with socio-constructivist teaching models in which students' previous competences are taken as the foundation, and independent, critical, and reflective learning is encouraged (Vega & Sampedro, 2021). It is important to tailor these reforms to the features of present-day society, and in particular to the transformation we have seen in the role of teachers, students, and the everyday and daily use of Information and Communication Technologies (ICT) in teaching-learning processes (Prieto et al., 2016).

ICTs are becoming increasingly relevant in academia mainly due to their potential to change the nature of the teaching-learning process (Marin et al., 2022). As noted by Aznar et al. (2021, p.18), ICTs "have gone from being a simple support tool in the classroom to becoming an inseparable component of current pedagogical processes".

Therefore, classroom teaching methods and the learning processes of students and teachers have undergone major changes, given the urgent need for children, teenagers, and young people to receive a comprehensive digital education in line with the demands of society today. This is also reflected in the incorporation of so-called emerging technologies by the various Horizon reports (Becker et al., 2018; Brown et al., 2020), which have highlighted the strong presence of both Virtual Reality (VR) and Augmented Reality (AR) in educational institutions (Brown et al., 2020; Marin and Vega, 2022). Likewise, the growth of these two technologies has led to incipient discussions about Mixed Reality (MR).

These methodologies can and will play an important role in the teaching-learning process, since they are starting to be seen as a technological resource that allows both the teaching and learning processes to become more enjoyable and effective (Araiza-Alba et al., 2021). That said, digital learning environments must be created that meet the need for real interaction with the physical space, where the characteristics of students are taken into account, and immersive learning is promoted. Virtual and mixed realities provide just such an opportunity (Marin et al., 2022).

1.1. Virtual Reality in Education

In the 1980s, the rise of ICT highlighted how some digital resources that had not been created for education nonetheless offered major potential in this field. In that scenario, VR provided a digital resource that could revolutionise classroom teaching models (Marin et al., 2022). In their study, Huan et al. (2019) point out that when a user—in this case, the student—places their focus on a virtual environment, they immediately form a mental representation of what they are seeing and transfer their

physical environment to the mental one. The sense of being part of that scenario is associated with enjoyment, and the acquisition of content occurs in a positive way.

Virtual Reality (VR) according to Roehl (1996) "is the simulation of a three-dimensional computer-generated environment, in which users have the ability to see and manipulate the contents of the environment". It is a simulated environment, built in a digital format, and consists of both visual and auditory effects to allow users to perceive or feel that they are in a real environment or space.

As Magallanes et al. point out. (2021, p. 104), students "can interact fully with the artificial environment using their sense of touch, hearing and sight through special devices that are connected to the computer", because they are transported to a virtual world where the psychological sensation causes you to feel immersed in a recreation of the real world.

1.2. Mixed Reality in Education

MR, also known as hybrid virtual reality, is a combination of AR and VR. It merges both the real world provided by AR and the virtual world provided by VR, all combined in a real physical and digital environment that allows users to interact directly with the object (Tang et al., 2018; Yusoff et al., 2011).

According to Miller (2017), the challenges presented to the user by MR through an immersive experience, achieved by means of tangible and verbal interaction, mobilise skills that the subject promotes for the learning process, both consciously and semi-consciously, because the information is presented in a more realistic and authentic way.

1.2.1. Advantages and disadvantages of using Mixed Reality in education

One of the most prominent advantages to using MR in the teaching-learning process in education settings is that it promotes a better understanding of the complexity of content and encourages independent learning (Juca et al., 2020). Furthermore, MR develops greater motivation and interest in learning the contents of the topic (Guervos, 2019; Ivars-Nicolas & Martinez-Cano, 2020), and allows students to experience the learning environment or context more fully, which helps to improve their perception of details in the things they are learning.

Furthermore, the outcome of the action or activity is immediate, visible, and palpable, and thus provides tools for problem solving (Rosati-Peterson et al., 2021). Bower et al. (2020) argue that it improves spatial capacities, promotes empathy, and increases motivation to learn new content and develop key competences in line with national guidelines and regulations in this area, including the 2006 Education Act of 3 May (2/2006, Jefatura del Estado, 2022) and Act 3/2020, of 29 December, which amended the 2006 Education Act (2/2006, Jefatura del Estado, 2020), as well as international directives (Council of the European Union, 2018).

The disadvantages or limitations of using MR in education include a lack of training in the use of MR among both teachers and students, and even more so a lack of proficiency in the creation, implementation, and evaluation of resources carried out within MR that favour the learning of various curricular contents and the development of key competences (Palomo, 2020). In addition, spatial constraints, in terms of the actual physical environment, can be a great handicap, as obstacle-free classrooms are needed. Furthermore, as with VR, the lack of financial resources and the high cost of both software and hardware limits its use at the different stages of education (Marin et al., 2022; Sandoval-Poveda & Tabash-Pérez, 2021), along with the lack of materials (VR cameras and goggles) (Coitinho et al., 2019).

However, despite these disadvantages or limitations, more and more experiences are emerging in different areas of the curriculum in which classroom methodology has been designed based on these emerging technologies. These include experiences in the field of education (Gold & Windscheid, 2020), physical education (Teixeira et al., 2021), biology (Joglar & Rojas-Rojas, 2019) and history and art, among others (Guerra et al., 2019).

1.2.2. Research and Innovation Experiences Related to Virtual and Mixed Reality

According to Maquilón et al. (2017), the possibility of incorporating this resource in the field of education will bring major benefits for teaching and student learning. Palomo (2020) notes that students have more sensory, visual, and auditory stimuli in creating and acquiring the concepts of depth, distance, and movement when using MR to learn. Along these lines, the results achieved by Kumar et al. (2020) with students in the area of health sciences show that the use of hololens MR headsets provided students with three-dimensional models that improved their sense of depth, while providing a better understanding of human anatomy. These authors point out that users can manipulate and explore a real environment through these holograms, which allows them to interact with the information that they provide directly, an aspect that VR, for example, does not offer. Weng et al. (2018), working with a group of elementary students from Indonesia, compared the feasibility of using MR-enriched books for content learning.

As we can see, experiences with emerging technologies are becoming increasingly prominent (Villalustre, 2020; Marin & Vega, 2022), and the use of VR and MR through 360° videos has been gaining ground recently.

The use of videos produced in 360° within education offers a perspective that traditional 16:9 videos could not and cannot provide (Gold & Windscheid, 2020). Three-dimensional videos allow for considerable immersion, close to the reality of the training scenario, which is why they have become the standard in certain fields. Along these lines, Pérez-Seijo et al. (2018) indicated that the use of immersive platforms that offer 360° videos promotes greater visibility of content. Furthermore, Maldonado et al. (2020) used 360° videos with university students and found that the learning process framed by this technology improved the interest, engagement, and collaboration of students in the subjects, mainly because they went from being a passive consumer or receiver of videos to being the creator of their own 360° learning videos (Marin & López, 2022).

The use of 360° videos allows students to get closer to daily reality, as well as to other content related to the subjects of the school curriculum.

This paper, therefore, addresses one of the objectives proposed by the R&D/Innovation project “Design, implementation and evaluation of mixed reality materials for learning environments” (PID2019-108933GB-I00), specifically objective 2, “Design and implement mixed reality materials that facilitate the acquisition of curricular contents and the attainment of key competences in secondary school learning environments”; which is partly developed in the following sections as a pedagogical proposal.

2. MATERIALS AND METHODS

2.1. Materials

The contribution presented here encompasses a pedagogical sequence to be implemented in Spanish secondary school classrooms. It takes into account the target key stage, in other words students aged 12 to 16, and the legislation in place in this country surrounding education. However, as the intended outcome is to create learning environments that enhance the development of students’ competences, it is applicable internationally throughout Europe, bearing in mind the recommendations of the European Council (Council of the European Union, 2018). It is based on active and participatory methodologies, grounded in student-led learning.

2.1.1. Objectives

The main objective of this didactic proposal is to design, implement and evaluate materials based on the architecture of MR that favour the learning of various curricular contents and the development of key competences among secondary school students. This overarching aim is developed through the following specific objectives:

- Offer secondary school students experiences that interconnect the contents studied at school during this key stage with the reality of the society in which they are immersed.

- Provide innovative and participatory learning environments, in which students are actively involved and regulate their own pace and needs.
- Provide teachers with innovative practices that consider the use of MR, in order to take into consideration their perceptions about the implementation of it.

2.1.2. Beneficiaries

This proposal is aimed at two types of beneficiaries. The primary beneficiaries will be students at a secondary school in the province of Cordoba (Spain). More specifically, we will work with 50 students aged between 14 and 16, who are enrolled in the third year of secondary education. Their defining characteristics are that they are in the evolutionary stage of adolescence, are fully proficient in the use of portable devices (Smartphone, Tablet, ...), and frequently use social media, video games and the architecture of AR, VR, and MR (Martin & Micaletto, 2021).

The secondary beneficiaries are the teachers of those primary beneficiaries. There are eight teachers in total, all working at the same school, specialising in different areas and fields of knowledge, with different professional backgrounds. In general, they have more than 5 years' teaching experience. Their ages range from 36 to 50, and their main personality traits are enthusiasm and innovation.

2.2. Methods

In this section, we include the curricular elements that characterise this stage and year of schooling in Spain's education system, and their adaptation in this pedagogical proposal, in order to show the manifestation and materialisation of the characteristic culture and knowledge of compulsory secondary education, which nuances the teaching-learning process.

We mentioned before that the proposal is aimed at students in the third year of compulsory secondary education. The 2006 Education Act of 3 May (2/2006, Jefatura del Estado, 2022) and Act 3/2020, of 29 December, which amends the 2006 Education Act (Jefatura del Estado, 2020), indicate under section 23 the twelve general learning outcomes that students must achieve by the end of this stage. Therefore, these learning outcomes should be attained over the course of the four years that make up this key stage. The outcomes that would be addressed in this proposal are:

- e) Develop basic skills in the use of information sources to acquire new knowledge through a critical lens. Develop basic technological skills and an ethical reflection on their operation and use.
- f) Understand scientific knowledge as integrated knowledge, structured into different disciplines, and understand and apply methods to identify problems in the various fields of knowledge and experience.
- j) Know, value, and respect the basic aspects of one's own and others' culture and history, as well as artistic and cultural heritage.
- l) Appreciate artistic creation and understand the language of the different artistic manifestations, using different means of expression and representation.

The methodology followed when implementing this didactic proposal will be globalising and multidisciplinary, striving to attain a dual perspective: on the one hand, the coordination and joint work of the group of subject teachers involved and the university education agents carrying out the R&D/Innovation project (PID2019-108933GB-I00), from which this experience has emerged. And, on the other hand, the need to propose a competence-based task in which knowledge of different disciplines and areas of knowledge is combined to promote effective, continuous, enriching, and interrelated learning, progressing in the acquisition of competences, performance, and wholeness.

Bearing this in mind, and even through the different curricular elements, knowledge, specific competences, and evaluation criteria are described below individually, they will be addressed simultaneously in the teaching-learning process carried out in the classroom.

The basic knowledge, specific competences, and evaluation criteria considered in this pedagogical proposal for students in the third year of compulsory secondary education, for the subjects of Artistic,

Visual and Audiovisual Education (Table 1); Geography and History (Table 2); and Mathematics (Table 3), are shown below.

Artistic, Visual, and Audiovisual Education	Description
Specific competences	5. Produce individual or collective artistic pieces with creativity and imagination, selecting and applying tools, techniques, and media according to their intentionality, to express their own vision of the world, emotions, and feelings, as well as to improve their capacity for communication and to develop critical reflection and self-confidence. 6. Appropriate cultural and artistic references from their surrounding environment, identifying their singularities, in order to enrich their own creations and develop personal, cultural, and social identity. 8. Share productions and artistic manifestations, adapting the project to their intentions and the characteristics of the target audience, in order to assess different opportunities for personal development.
Evaluation criteria	5.2 Produce different types of individual or collective artistic pieces, justifying the creative process, showing initiative and self-confidence, integrating rationality, empathy, and sensitivity, and selecting the appropriate techniques and media for their intended purpose. 6.1 Explain their belonging to a specific cultural context, by analysing the formal aspects and social factors that determine different cultural and artistic productions today. 6.2 Use cultural and artistic references from the surrounding environment creatively when making their own productions, displaying personal vision. 8.2 Develop productions and artistic manifestations with prior intention, individually or collectively, organising and developing the different stages and considering the characteristics of the target audience. 8.3 Describe the processes of creation and the final result of artistic productions and manifestations, carried out individually or collectively, recognising the mistakes made, seeking the most appropriate solutions and strategies to improve them, and appreciating the opportunities for personal development that they offer.
Basic knowledge	Visual and audiovisual image and communication. – Language and visual communication. Aims: informative, communicative, expressive, and aesthetic. Contexts and functions. – Visual and audiovisual images: reading and analysis. – Still and moving images, origin and evolution. Introduction to the different features of comics, photography, cinema, animation, and digital formats. – Basic techniques for making simple audiovisual productions, individually or in groups. Experimentation in virtual learning environments.

Table 1. Curriculum Elements for Artistic, Visual and Audiovisual Education

Source: Royal Decree 217/2022, of 29 March, of the Ministry of Education and Vocational Training.

Mathematics	Description
Specific competences	1. Interpret, model, and solve everyday problems and mathematics problems, applying different strategies and types of reasoning, to explore different ways of proceeding and obtaining possible solutions. 6. Identify the mathematics involved in other subjects and in real situations that can be addressed in mathematical terms, interrelating concepts and procedures, to apply them in diverse situations.
Evaluation criteria	1.1 Interpret mathematical problems by organising the data, establishing relationships between them, and understanding the questions asked. 1.2 Apply appropriate tools and strategies that contribute to problem solving. 1.3 Obtain mathematical solutions to a problem, activating knowledge and using the necessary technological tools. 6.2 Identify coherent connections between mathematics and other subjects by solving contextualised problems. 6.3 Recognise the contribution made by mathematics to the progress of humanity and to overcoming the challenges of today's society.
Basic knowledge	A. Number sense. 2. Quantity. – Estimate with the required precision. 5. Proportional reasoning. – Ratios and proportions: understanding and representing quantitative relationships. – Situations of proportionality in different contexts: analysis and development of methods for solving problems (percentage increases and decreases, price reductions and increases, taxes, scales, foreign exchange, speed, and time, etc). C. Spatial sense. 1. Two- and three-dimensional geometric figures. – Geometric relationships such as congruence, similarity and the Pythagorean ratio in flat and three-dimensional figures: identification and application. – Construction of geometric figures with manipulative and digital tools (dynamic geometry programmes, augmented reality...). 2. Location and representation systems. – Spatial relations: location and description by means of geometric coordinates and other systems of representation. 4. Visualisation, reasoning, and geometric modelling. – Geometric modelling: numerical and algebraic ratios in problem solving. – Geometric ratios in mathematical and non-mathematical contexts (art, science, daily life...).

Table 2. Curricular elements for Geography and History

Source: Royal Decree 217/2022, of 29 March, of the Ministry of Education and Vocational Training.

Mathematics	Description
Specific competences	1. Interpret, model, and solve everyday problems and mathematics problems, applying different strategies and types of reasoning, to explore different ways of proceeding and obtaining possible solutions. 6. Identify the mathematics involved in other subjects and in real situations that can be addressed in mathematical terms, interrelating concepts and procedures, to apply them in diverse situations.
Evaluation criteria	1.1 Interpret mathematical problems by organising the data, establishing relationships between them, and understanding the questions asked. 1.2 Apply appropriate tools and strategies that contribute to problem solving. 1.3 Obtain mathematical solutions to a problem, activating knowledge and using the necessary technological tools. 6.2 Identify coherent connections between mathematics and other subjects by solving contextualised problems. 6.3 Recognise the contribution made by mathematics to the progress of humanity and to overcoming the challenges of today's society.
Basic knowledge	A. Number sense. 2. Quantity. – Estimate with the required precision. 5. Proportional reasoning. – Ratios and proportions: understanding and representing quantitative relationships. – Situations of proportionality in different contexts: analysis and development of methods for solving problems (percentage increases and decreases, price reductions and increases, taxes, scales, foreign exchange, speed, and time, etc). C. Spatial sense. 1. Two- and three-dimensional geometric figures. – Geometric ratios such as congruence, similarity and the Pythagorean ratio in flat and three-dimensional figures: identification and application. – Construction of geometric figures with manipulative and digital tools (dynamic geometry programmes, augmented reality...). 2. Location and representation systems. – Spatial relations: location and description by means of geometric coordinates and other systems of representation. 4. Visualisation, reasoning, and geometric modelling. – Geometric modelling: numerical and algebraic ratios in problem solving. – Geometric ratios in mathematical and non-mathematical contexts (art, science, daily life...).

Table 3. Curricular Elements for Mathematics

Source: Royal Decree 217/2022, of 29 March, of the Ministry of Education and Vocational Training.

Finally, the following key competences will be integrated in the didactic proposal: literacy, mathematics, and science; technology and engineering; digital; entrepreneurial; conscience and cultural expressions.

2.2.1. Temporal-spatial organisation and resources

Spatial and temporal organisation, as well as the resources needed to design and implement any educational action that involves a teaching-learning process, should be taken into consideration to ensure greater effectiveness and efficiency. In this regard, the spatial perspective will consider primary (personal and family) and secondary (school) contexts; the environments will also vary according to each group of students. However, everyone will attend the regular classroom and the technology classroom.

In relation to the temporal aspect, the didactic sequence will be covered over the course of one term, 12 weeks, with three lots of one-hour sessions per week. In the final week, there will be five lots of one-hour sessions to present the final product to all the other students in the year.

Finally, the resources required to carry out this didactic proposal are mainly technological: Tablet, Smartphone, AR and VR computer software, and computers.

3. RESULTS

This section describes the task and activities encompassed by the didactic proposal, which includes the experience using MR to facilitate the acquisition of curricular content and the achievement of key competences, since they are the outcomes of the innovation proposal.

As an initial activity, all students in the third year of a secondary school in Cordoba, where the proposal will be implemented (50 students), will meet in the school hall. They will then use their smartphones to scan a QR code that will be projected by the R&D/Innovation project team (PID2019-108933GB-I00), which has an embedded link, taking them to a 360° video for them to watch, which includes Cordoba's Mosque, as an example of monumental heritage of humanity and history. They will be able to take a virtual tour of the building, see its layout, structure, and historical development, and also learn some key digitised artistic and mathematical aspects that are embedded in the video.

They will then engage in a debate, reflecting on the social and cultural aspects of this monument throughout history.

Next, they will be presented with the competence-based task that they will be working on over the course of a term (12 weeks), three hours a week with six subject teachers and two tutors in the technology classrooms. For this task, they will be working on a multidisciplinary project in groups of 4 or 5, to design, create, and disseminate a 360° video with elements of virtual and augmented reality on any of the city's historic monuments or sites, encompassing history, culture, and the heritage it represents for the city, as well as mathematical elements of geometry, location, and estimates. They will be told that, during the last week, each group will give a thirty-minute presentation to their classmates detailing what they have done. These presentations will take place in the hall. To follow up on and monitor this experience, the teachers working on this project will be assigned to the school for eleven weeks to support the subject teachers and students in the MR teaching-learning process.

Some of the activities they will carry out at part of this multidisciplinary project are shown in table 4. Because it is a globalising proposal, they are not classified by subject area. However, all teachers from the different areas of knowledge, as well as the team from the R&D/Innovation project (PID2019-108933GB-I00), will be present and supporting each of the groups through the process. In addition, all proposed activities will be carried out in small groups of 4 or 5 people.

Activity	Specific competence
1. Each of the groups will choose an historic monument or site, indicating briefly why they chose it from a social, cultural and heritage point of view, and sharing this document in the Google Classroom app with the teacher and the members of their group.	7 (Geography and History)
2. Identify and find images of the cultural and artistic references pertaining to the historical monument or site selected in the previous activity. Analyse the artistic and emotional aspects evoked by these images. The images should be captured on a family visit to the monument.	6 (Artistic, Visual, and Audiovisual Education)
3. Calculate the distance and coordinates of the monument from the school, using the Google Maps app.	6 (Mathematics)
4. Plan and capture the images they will take of the monument, which will subsequently be put together to create the 360° video. They will then analyse them from an emotional, artistic, cultural and communicative perspective.	5 (Artistic, Visual, and Audiovisual Education)
5. Study, analyse, and identify in the above images the proportions of the geometric figures found in the historical monument or site, in both two and three dimensions.	6 (Mathematics)
6. Select information about the monument chosen (period, culture...) using Google Scholar and search engines.	1 (Geography and History)
7. Calculate the numerical and algebraic ratios of the dimensions of the figures found in the monument (height, width, diagonals, angles, ...)	1 (Mathematics)
8. Using the 3D figure creation app Tinkecard, they will model the monument in AR, reflecting on the estimation and precision of measurements, proportional ratios, and spatial relationships, which must be representations of the geometric figures captured in the images.	1 (Mathematics)
9. They will then create their audiovisual production using the “capture 360°” option in the Google Street View app, whereby photographs of the historical monument or site will be taken in 360° using their mobile and/or smartphone. Later, using the Pano2VR app, they will stitch the images together to create the video.	5 (Artistic, Visual, and Audiovisual Education)
In order to carry out this activity, families must accompany the group of students to the chosen site.	
10. They will create the VR and AR elements to be embedded in or outside the 360° video to support the historical, heritage, and cultural explanation of the selected monument. To do this, they will use the free version of the UNITY software package for AR, Tinkecard, and Pano2VR	1 and 7 (Geography and History)
11. They will write up the mathematical aspects and curiosities found in the selected monuments.	6 (Mathematics)
12. The groups will present their multidisciplinary project, which contains elements in MR, VR and AR, from a historical, cultural, affective-emotional, mathematical, and artistic perspective.	8 (Artistic, Visual and Audiovisual Education); 1 and 7 (Geography and History)

Table 4. Proposed activities and their relationship to specific competences

Source: authors' own

Some of the activities could develop different core areas of knowledge and more specific competences. However, we have given a clear example of the latter to make the curricular sequence easier to understand.

In this section, we should also underscore the planning and programming of the teachers involved, since these are the teaching activities that feed into this process, as pre and post instructional, personal, situational, and methodological variables (Brailovsky, 2020). Teachers must coordinate and collaborate with each other, maintaining constant communication to guide the students through the various activities, since they share a common space and time during this project, without that specialised component afforded by their area of knowledge. There is also a high degree of transformation in the teaching-learning process with the use of MR, to create effective learning environments and ultimately digital proficiency.

4. DISCUSSION

Discussion of this proposed experience emerges from the comparisons made between the task and activities carried out by students in the third year of compulsory secondary education, the subject teachers for three areas of knowledge - Artistic, Visual and Audiovisual Education, Geography and History, and Mathematics - the curricular elements considered for the teaching-learning process, and the specific objective underlying the R&D/Innovation project (PID2019-108933GB-I00), "Design and implementation of mixed reality materials to facilitate the acquisition of curricular content and achievement of key competences in compulsory secondary education learning environments".

In light of the pedagogical sequence presented here, we can say, with regard to "Providing secondary school students with experiences that interconnect the contents studied at school during this stage with the reality of the society in which they are immersed", the activities and the task relate contents from different areas of knowledge based on the educational legislation in force within Spain for this key stage (LOE, 2006; LOMLOE, 2022), whilst also considering the key competences proposed by the EU in terms of the emerging technological reality in which students are developing.

5. CONCLUSIONS

Following the study by Miguélez-Juan et al. (2019), the need to renew teaching and learning methods is becoming increasingly evident so as to deliver competence-based teaching and learning in line with current educational legislation (LOE, 2006; LOMLOE, 2022). In relation to the results obtained in this study, some of the most outstanding advantages or benefits of using MR have been the chance to experience things first hand, the possibility of developing ubiquitous learning, and sparking greater motivation, allowing students to be part of their own education process, as another element to it, coinciding with the study conducted by Juca et al. (2020).

The students noted that, having created their 360° videos, and after the full experience gained with MR, they were able to retain more information and better apply what they had learned. These results are similar to those found by Krokos et al. (2019).

These kinds of pedagogical experiences can enhance the interdisciplinary nature of different subjects. They can also facilitate more competence-based learning that is closer to the daily realities experienced by teenagers through the use of audiovisual and technological resources (Salica, 2021), enabling them to understand in greater depth and internalise the general culture they need in the 21st Century society.

The requirements set out in educational legislation necessitate didactic programming that includes the possibility of offering students different methods and strategies that lead to collaborative projects, which foster the development and improvement of attitudes and skills they need to live and evolve in technological contexts, in which initiative, creativity, and enterprise are crucial.

Finally, and coinciding with previous studies (Gómez-García et al., 2020; Marin et al., in press), the teachers have stated that they need training in the use, creation, implementation, and evaluation of resources based on the use of MR, such as the creation of 360° videos.

ACKNOWLEDGEMENTS

This article is funded as part of the R&D/Innovation project entitled “Design, Implementation and Evaluation of Mixed Reality Materials for Learning Environments” (PID2019-108933GB-I00) granted by the Ministry of Science, Innovation and Universities.

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