IS THERE AN "A" IN STEAM? THE ART PROJECT

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Abstract

STEAM projects are in vogue, with a large number of countries promoting the development of STEAM projects, but mainly related to science, technology and mathematics. We are moving, therefore, in the STEM world. The ART project also aims to work with technology, through the use of Virtual Reality, but using it to make Art and Culture more inclusive and accessible. Through the use of Virtual Reality glasses, young school children can access museums, churches, and buildings of different cultures existing in different countries of the European Union. This technology can help develop digital skills and introduce schoolchildren to a rapidly changing target world, and also encourage cultural diversity, acceptance of differences, and knowledge of Europe's cultural richness, thus developing European citizenship through art and virtual reality.

Introduction

We are in the midst of a changing environment, where Information and Communication Technologies (ICT) have set the pace for transforming our world. Education has also been affected by this scenario. The ubiquity of learning is a fact from the moment we can access a large amount of information from mobile devices.

On the other hand, ICTs have allowed us to start thinking about more participative and collaborative learning models thanks to tools that are becoming more and more horizontal, eliminating communication barriers.

The Information Society is, in reality, the Learning Society, where the essential value is in the process of how we learn. Considering that industry is heading towards a fourth revolution with disruptive effects that affect employment, consumption, government activity and, of course, our lives, innovation is essential to face the challenges that are opening up before our eyes (Amor, 2018).

When we talk about innovation, we are referring to a change that allows us to improve, and from this point of view, experts in the field consider that this is directly related to Science, Technology, Engineering and Mathematics, with the acronym STEM. This has conditioned the idea that in order to have qualified jobs, training should be in these subjects.

However, in recent times, the importance of also including the Arts as an essential discipline for the needs of our world has begun to be debated. Thus, the latest references to the most innovative skills for the 21st century make it necessary to add the "A" to the acronym STEM, turning it into STEAM.

It is important to insist that the STEAM approach is not only about teaching content, but also about competences and types of thinking. It is about developing students' creativity, in such a way that it enhances innovation and logical thinking, in order to associate logical thinking and creativity, thus increasing interest in science (Soriano, 2021).

However, the subjects included in STEM still do not solve the problems derived from the jobs offered in these areas, such as the fact that there are still few professionals for the needs detected (especially of the female gender). Furthermore, and furthermore, qualification deficits exist. But if we focus on the field of visual arts and design, according to Amor (2018), the problem is even more pronounced in terms of content, skills, and student training.

Some authors point out that, in general, the study of science subjects among young people in Europe has declined (Robles et al., 2015). There is difficulty in generating scientific literacy among citizens and, from this perspective, Rocard et al. (2007) warn that this is due to the way science is being taught in schools. In this sense, authors such as Solbes (2011), Solbes et al. (2007), and Lozano Lucia (2012) have investigated the factors that are influencing dropout, as well as what innovative proposals could be addressed to tackle these attitudes. They conclude that the solution lies in compulsory education, which may be a key moment to motivate students towards science or improve their attitude, since they have to study it compulsorily.

Our current study includes a questionnaire to assess the expectations and beliefs that teachers in compulsory secondary education and vocational training in Spain may have about gender and science. When asked about which disciplines or areas of study their students would choose or had chosen, it was found that the arts were in last place for both genders. However, when asked about competences, separated by gender, teachers indicated that girls excelled in artistic skills (De Pablo & Sanz-Prieto, 2022). One might wonder why girls, despite possessing artistic skills, in the choice of disciplines do not favor the art disciplines, but rather the opposite is true.

Following Amor (2018), both the scientific and artistic profiles have common characteristics in terms of certain competences, such as problem solving, understanding failure as part of the process, and the effort in a continuous learning process based on trial and error.

In this sense, Amor continues with the reflection that it would be good for schools to stop projecting traditional perceptions of associating good students with mathematics, or that the arts do not provide job opportunities (a belief that is also widespread in families). Both groups, those who are good at mathematics and those who are good in the arts, must acquire digital, humanistic, and social skills in order to provide a complete response to the information and knowledge society (Amor, 2018). In other words, they must adapt to the Learning Society.

This Society is also a global society in which goods, people, and ideas increasingly cross borders. It is the global citizenship that has to cope with global challenges such as climate change, availability of food, water, etc. This requires us to be increasingly empathetic to the interests and realities of other cultures as well as the effect of our existence on other parts of the world. And for this to happen, we must train our students to be innovators in solving these global problems. All this movement of people is leading to different work scenarios as well, as organisations have to work more and more internationally, thus also having more and more foreign employees (Directorate-General for Communication et al., 2010). Also, government agencies have to deal more and more with people from other countries. In conclusion, our world is becoming smaller and more connected.

Many authors point out that in order to be a citizen of the world, it is necessary to be individuals with global social responsibility, and this task arises from the process of internationalisation. This internationalisation must be linked to higher education and is a very relevant issue for today's societies, which are immersed in a changing world that requires responsible and collaborative actions (Santamaría-Cárdaba & Lourenço, 2021). It is not in vain that this is a United Nations (2015) Sustainable Development Goal, which insists on being able to address the development of a global citizenship that profoundly transforms our society. There is a strong need to form autonomous and critical citizens who promote an ethical and ideological assessment of the world, as well as the projection of what it would be desirable for it to be (Celorio & López de Munain, 2007; Boni, 2014).

It is therefore essential to promote STEAM teaching in the education and training system, taking advantage of the fact that the rise of intelligent technologies, such as virtual reality, can contribute to making the learning of any of these disciplines much closer and more inclusive. In short, we need to talk about bringing all knowledge closer together without categorising first- or second-order disciplines.

The ART Project

ART (Art and culture Recorded for e-Ternity, n.d.) is a project co-funded by the European Union's Erasmus+ programme; it has a duration of 27 months having started on 1 March 2021. Its main objective is to make different museums and other

cultural institutions more accessible to students aged 8-16 through the use of virtual reality, but also trying to reach other target groups such as teachers and education students who will become teachers in the near future.

The partners and countries involved in the project are the following:

- Stichting Kenniscentrum Pro Work (Netherlands) – Coordinator
- Sinergia Società Cooperativa Sociale (Italy)
- Artevelde Hoge School (Belgium)
- Euroface Consulting s.r.o. (Czech Republic)
- Fundación Siglo22 (Spain)

The main objectives of the project are to:

- Teach students the ability to **think critically** and to **form an opinion**
- Promote European (and Global) **Citizenship**
- Develop empathy to the interests of other (**different**) people

The project will generate different results, from a research study with expert staff in the field of educational innovation, to a basic and progress questionnaire related to the concepts of European citizenship. But probably the most outstanding development is an online platform with virtual reality material from museums and religious centres of all faiths, including, in the immersive experience of virtual reality, educational materials to be used during the virtual visit. And of course, the project includes a phase for use of the developments by the target audience.

In this way, the project aims to enable students to acquire cultural, artistic, and historical knowledge. They will also learn to develop critical thinking skills and foster respect and tolerance in the classroom.

Results of the Citizenship Questionnaire

Analysing the results of the questionnaire includes comparing results before using the Virtual Reality (VR) resources and afterwards, to see if there are differences and how the concept of digital citizenship varies. This paper will focus on only some of the survey questions, mainly because of their importance to how the VR resources developed in the project may affect the concept of Digital Citizenship, specifically European citizenship.

The survey was answered by 670 students, 441 of secondary school and 229 of primary school (Table 1).

Table 1

Students' Answers to ART Project Citizenship Questionnaire

	TOTAL	Female	Male
Primary	229	103	126
Secondary	441	168	273
TOTAL	670	271	399

One revealing question is Question 13, which asks students to choose the answer that suits them best with respect to how they identify:

- I primarily identify myself as an inhabitant of my village/town
- I identify myself as a citizen of my country
- I identify myself as European
- I identify myself as a world-citizen

The option with the lowest acceptance is "I Identify myself as European" (Table 2); in both study levels and in all the countries in the project except for the Czech Republic, where it is the highest with 46.79%.

Table 2

How Do I Identify Myself?

	I primarily identify myself as an inhabitant of my village/town	I identify myself as a citizen of my country	I Identify myself as European	I identify myself as a world-citizen
Belgium	19.50%	**43.50%**	*15.50%*	21.50%
Czech Rep.	11.93%	31.19%	**46.79%**	*10.09%*
Spain	22.22%	**39.68%**	*0.00%*	38.10%
Italy	18.90%	26.77%	*11.02%*	**43.31%**
Netherlands	**50.00%**	29.55%	*6.82%*	13.64%
AVERAGE ALL COUNTRIES	20.30%	**33.88%**	*16.87%*	28.96%
Primary	18.34%	27.07%	*13.97%*	**40.61%**
Secondary	21.32%	**37.41%**	*18.37%*	22.90%

Note. For each row, the highest percentage is bold-faced in green, and the lowest percentage is italicized in red.

It is interesting how low identification as a European is, especially in Spain (0%), but also in The Netherlands (6.82%) and in Italy (11.02%). In contrast, in Belgium, it is also the lowest (15.5%) but is close to the average for all the countries (16.87%).

The highest option for each country differs widely. In Italy this is "I identify myself as a world-citizen" (41.31%; in contrast, this is the lowest in the Czech Republic with 10.09%). In The Netherlands the highest option is "I identify myself as an inhabitant of my village/town" with 50.0%. And for Belgium (43.50%) and Spain (39.68%), the highest option is "I identify myself as a citizen of my country (though for Spain this figure is very similar to how they identify themselves as a world-citizen, which is 38.10%).

These results suggest that there is certainly great room for improvement when it comes to the personal perception of students as Europeans, and that is something that all Erasmus+ projects should somehow strive for.

Questions 14 to 18 also worth examining close. The questions were:

14. I want to learn more about how people live in other countries/cultures.
15. I want to learn more about other religions.
16. I'm interested in how people from other countries look at the world.
17. I'm interested in the history of other countries.
18. I'm interested in art (paintings, architecture, sculptures …) that was made in other countries.

For all these questions, the scaled options were:

- This doesn't interest me at all
- I find this kind of interesting
- I find this quite interesting
- I find this very interesting

The results for this set of questions are summarized in Table 3.

It is clear that religion is the subject they are least interested in, with 18.51% indicating it doesn't interest them at all and only 15.07% indicating they are very interested in learning more about other religions.

Table 3

Summary of Responses to "I Want to Learn More about…" and "I am Interested in…"

	This doesn't interest me at all	I find this kind of interesting	I find this quite interesting	I find this very interesting
I want to learn more about how people live in other countries/cultures.	*4.03%*	27.31%	**38.36%**	30.30%
I want to learn more about other religions.	18.51%	**38.96%**	27.46%	*15.07%*
I'm interested in how people from other countries look at the world.	*10.90%*	25.97%	**37.01%**	26.12%
I'm interested in the history of other countries.	*11.49%*	25.07%	**35.82%**	27.61%
I'm interested in art (paintings, architecture, sculptures …) that was made in other countries.	*17.76%*	**31.19%**	27.46%	23.58%

Note. For each row, the highest percentage is bold-faced in green, and the lowest percentage is italicized in red.

When we analyse the survey results by countries, we see that Spain is the country most interested in all the options, followed by Italy and Belgium. The Netherlands and especially the Czech Republic have lower interest in knowing about the different proposed topics.

Table 4

Breakdown by Country of Responses to ""I Want to Learn More about…" and "I am Interested in…"

	Belgium	Czech Republic	Spain	Italy	Netherlands	ALL
I want to learn more about how people live in other countries/cultures.	70.50%	*49.54%*	**80.95%**	72.05%	70.45%	68.66%
I want to learn more about other religions.	39.50%	33.03%	**63.49%**	46.06%	*29.55%*	42.54%
I'm interested in how people from other countries look at the world.	71.00%	50.46%	**85.71%**	61.02%	*38.64%*	63.13%
I'm interested in the history of other countries.	65.50%	*43.12%*	**74.60%**	68.50%	59.09%	63.43%
I'm interested in art (paintings, architecture, sculptures …) that was made in other countries.	52.50%	*22.94%*	**66.67%**	59.84%	40.91%	51.04%

Note. For each row, the highest percentage is bold-faced in green, and the lowest percentage is italicized in red.

It is interesting to note that the country where students feel the least European, Spain, is also the country where students demonstrate the biggest interest in knowing about other cultures, history, art, and even other religions.

In the ART project, we are going to be working on the issues getting the lowest ratings in the questionnaires, namely European Citizenship, using materials about art and also about religious buildings.

We will first discuss how we have created the 360º VR materials to be used by the primary and secondary students.

Virtual Reality Resources in the ART Project

The ART partners are creating virtual tours, which consist not only in beautiful pictures but also in various assignments and explanations which are taught about each partner's own active contribution to global citizenship.

The first step was to distribute the different religions among the project partners:

- ProWork (Netherlands) – Buddhism
- Sinergia (Italy) – Catholicism
- Artevelde (Belgium) – Protestantism
- Euroface (Czech Republic) – Judaism
- Siglo22 (Spain) – Islam

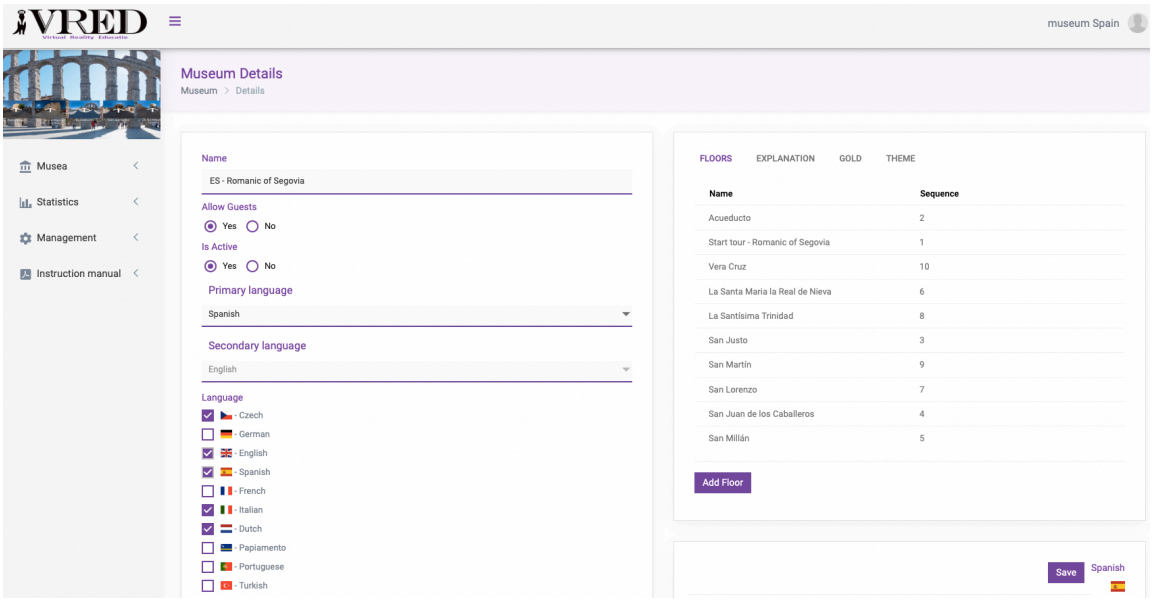
The creation of the virtual tours, including the educational content, was carried out using the Content Management System (CMS) called Virtual Reality Educative (VRED), which is shown in Figure 1. It allows educators of educational organizations to create, manage and administer educational content in their own 'VR tour' and changes in the CMS are immediately online.

The didactic approach of the VR materials has the following goals in mind for the students:

- Teach students the ability to think critically and form an opinion at an early age.
- Teach students the ability to collaborate and resolve conflicts.
- Teach students an international attitude including value orientation.
- Give students a positive self-image and teach respect for others.
- Teach students' social involvement and a sense of responsibility.

Figure 1

VRED CMS for creating the VR tours



With these objectives, the ART Project hopes to be able to contribute to the citizenship and responsibility of pupils in primary and secondary schools. To ensure maximum development, these goals should be linked to artworks or objects from a selection of religious or art institutions. This can be achieved by varying formats and exercises to maximize engagement.

Concerning didactics, they are the systematic and intentional aid provided by teachers to their pupils in schools, by means of cultural tools. In ART, in order to teach in a didactically responsible manner, we have taken into account the following didactic principles.

- *Visualisation*: this means teaching your pupils by providing lesson materials in a visual manner. This is mainly applied by providing images and videos, and visualising the steps students must go through when learning to do something new.
- *Motivation*: this means to be sure that the displayed facts and images appeal to your target audience (the pupils). Information should not be too hard or too easy.
- *Activation*: the lesson material should make students enthusiastic about the subject so they can manage to actively work in the lesson. Linking questions and activities (open questions, multiple choice, sorting exercises) to the VR-materials is essential.

- *Gradualness*: Challenge students by starting with easy questions and work gradually to more difficult and complex questions. There should be a logical order in the questions, so that students are challenged to improve.
- *Differentiation*: Consider the individual needs of your pupils. Pupils with learning disorders (e.g., dyslexia) and/or concentration disorders might have difficulties with reading long texts and complex sentences. Other students might need more challenges. All this should be taken in consideration to provide different formats and levels of difficulties.

The VRED-software is a basic tool which is used to develop VR-materials with the PICO Virtual reality headset. With respect to the educational items that may be included in the tours, this software is able to manage five different media types: 1) a fact/text; 2) an image (JPEG PNG RAW …); 3) a video-file (MP4 Youtube-link); 4) an audio-file (MP3 FLAC AAC); and 5) a question (multiple-choice and open questions).

The user may navigate the different museums and floors in them using the menus, as depicted in Figure 2, which also shows how the content cubes look inside the system.

Figure 2

Navigation Tools in the System

The 360º images were created using a Ricoh Theta Z1 camera and managed using the camera's own stitching software together with Adobe Photoshop. The VR glasses used to navigate the VR tours are PICO G2 4K.

The system has to be accessed with a user id and password, and each student has their own. Once inside, they get access to the general hall, where they are able to choose between the different museums and art buildings prepared, as can be seen in Figure 3.

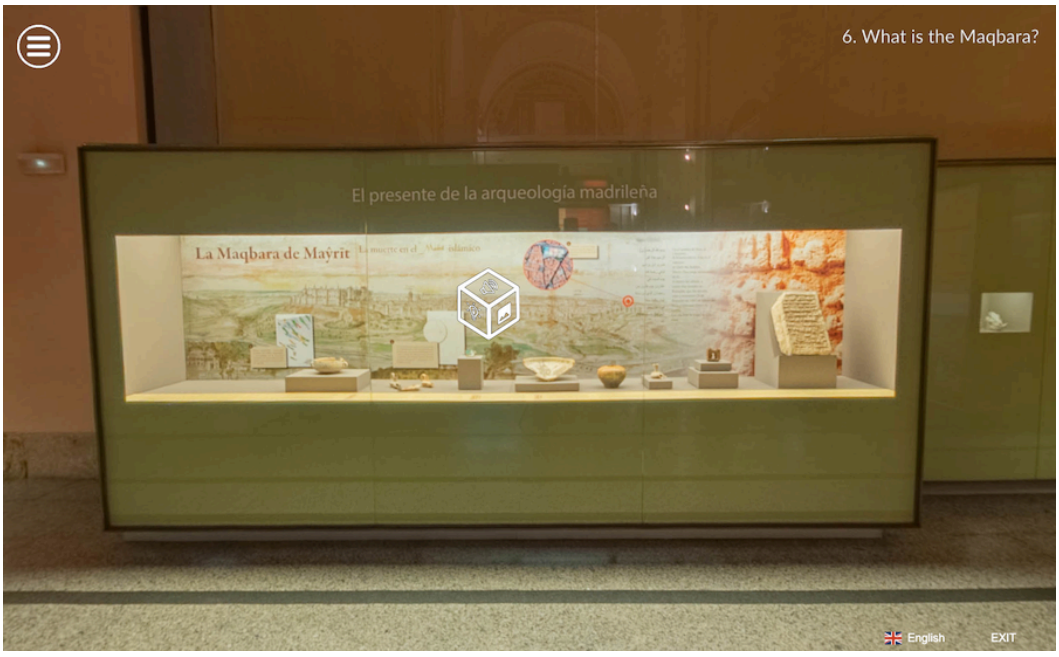
Figure 3

Entrance to VR System

The VR-Software allows adding an interactive cube, with the aspect seen in Figure 2, to every virtual environment with the items mentioned above. By interacting with the cube, the pupils get access to questions and information. This can be seen in the example of the Museum of Alcala de Henares (Madrid) shown in Figure 4.

Figure 4

Alcala's Museum Virtual Tour



Another useful application to be used where possible in the project is Storytelling, also known as Docufiction. It has been proven that a combination of historical fact with narrative fiction leads to an increase in both learning potential and engagement among the pupils (Vanoverschelde, 2019). The focus of Storytelling is therefore to increase the pupil's immersion (and equally their empathy). This is achieved by linking the lesson materials and VR-environment to a (non-)fictional narrative. While the story may be fiction, it is important that both the setting and facts remain grounded in what is reality and what is factual.

The project will proceed during 2023 with pilots in Primary and Secondary schools in all the project countries, and after that we will have a better idea if the ART project together with VR is able to increase interest in other cultures, religions, and art in our young citizens in Europe.

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