Creating a Visual Museum: Benefits and Obstacles – a Case Study

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Abstract

This article deals with students' work to create a virtual museum based on a given mock-up. The museum has been created both in Artsteps platform and PowerPoint and reference is made to the comparison between them. The students, using optical illusions, gave the museum visitor in PowerPoint the ability to navigate like in Artsteps. The achievement of cognitive goals, skills and attitudes, was investigated. the difficulties the students faced and the solutions they found are also presented in the article. The whole process was based on the Instructional Model of the five E stages. The students benefited in multiple ways not only by mastering the predetermined goals, but also, in order to achieve the common goal, a strong relationship was built between them, their need to learn about technology and cultural heritage issues increased and thus laid a stronger foundation for the multifaceted development of their personality.

Key words: Artsteps, 5E Instructional Model, PowerPoint, Virtual Museum.

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1. Introduction

Through the years, augmented (AR) and virtual reality (VR), are evolved in several technological domains, especially in education. There is a significant number of AR/VR developments, but the researches indicated a need for more in-depth studying all the characteristics for an effective educational procedure (Noah, & Das, 2021).

The latest research has recorded the multiple benefits of utilizing virtual museums, galleries, platforms (google arts, etc.) at all levels of education such as: ensuring guided discovery learning, direct observation of a work of art, raising students' awareness of the value of the museum, encouraging creativity, communication and interaction, strengthening teaching, improving student participation in learning teaching, increasing understanding of the content of teaching, and increasing the tendency of students to visit the real museum in the future (Franceschi, & De Miguel Álvarez, 2021; Katz, & Halpern, 2015; Verde, & Valero, 2021).

Virtual museums usually use VR or AR technologies and the literature review shows that the use of VR/AR in education is not new, but there is ambiguous evidence of effective learning gains using VR or AR technologies. It also shows that generalizing results has many difficulties. There is minimal research into combining VR and AR, and very few explorations about the social properties of social learning platforms. Even though the researchers suggest the combination of VR and AR and not the use of them as two completely separate technologies, there are only a few studies in "mixed-space collaboration" in the education field (Scavarelli, & Teather, 2021).

PowerPoint and ArtSteps are commonly used to create virtual museums in schools (Zouboula, Fokides, & Tsolakidis, 2008). Experimental findings indicate that virtual presentation with PowerPoint can be meaningful for learning in museums (Savva, 2013). Nevertheless, the virtual presentation with PowerPoint is technically difficult and less impressive than in ArtSteps (Rampaouni, 2018). On the contrary, ArtSteps is an easy-to-use and freely available platform successfully supporting interdisciplinarity and has a high degree of credibility (Fokides, & Sfakianou, 2017). As in VR environments many students pay more attention to graphics and less to information, PowerPoint seems to offer better cognitive results (Kleanthous, 2014).

The significance of our study lies in the further investigation of the utilization of virtual museums in education.

The main purpose is twofold: a) to investigate the benefits building a museum with PowerPoint and ArtSteps, mainly targeting at 21st century skills acquisition, such as collaborating, making hypotheses, taking decisions, self-organization, persistence, patience, time management, learning tactics of problem solving, but above all to research, experiment, implement ideas and presenting the work done, skills that will later be useful in the professional career of the students and b) to propose ways of planning a museum taking into account accessibility. The objectives are that the

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students could become able to combine knowledge from seemingly different fields, be able to explain and support their ideas, accept better ideas, and assess their work. The general question to be answered is "Is the creation of a virtual museum suitable for achieving the above?"

Below, we presented the theoretical framework, the project, the methodology, the way students worked, the problems they faced, their solution and the benefits that the students obtained. A discussion of the results and suggestions for future work follow.

2. The Theoretical Framework

2.1 Augmented Reality and QR codes

There are too many definitions of AR found in the international literature, but in a few words, we can say that "AR works through a device that shows virtual objects, animations, texts, data or sounds that the user views from the screen of a computer, a smartphone, a tablet, a pair of glasses, a headset or any other on-screen display system (Elmqaddem, 2019). In contradiction to VR, immersion in the virtual world is not total, because we can always see the real world around us.

AR applications are already implemented in education (Elmqaddem, 2019; Graf et al., 2015; Vosinakis, & Tsakonas, 2016). AR is directly connected to Quick Response (QR) codes and research has shown that young people and smartphone owners use QR codes in museums, since they can help them to personalize their visit to it. Museums are advised to use them since they can provide a cost effective and potentially powerful tool (Schultz, 2013). There is a great implementation of QR codes and AR in terms of museology, since they create a connection between the exhibit and the viewer. Mobile technologies, AR and QR codes can change the way we communicate cultural heritage (Jevremovic & Petrovski, 2012). Despite the wide use of QRs in various professional fields, their utilization in education is limited (Papadakis, & Orfanakis, 2016).

AR educational platforms should include accessibility which is a very significant concern in social learning spaces, such as classrooms and museums and it covers three main areas: Platform Scalability, Social Scalability, and Reality Scalability (Scavarelli, & Teather, 2021). Platform Scalability refers to a system capable of adapting to a range of AR capable platforms. Social Scalability is related to interaction, representation, engagement and satisfaction between interacting users. AR applications reduce geographical barriers and enhance users working together in classroom. Reality Scalability refers to the concept of an application allowing AR perspectives.

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2.2 Virtual Museums

There are many types of virtual museums. Amongst them, some are 3D representations of real ones and can help visitors organize their real visit to them, others are just a digital collection of 3D objects presented in a unified place, others just provide a 2D users interface (Vosinakis, & Tsakonas, 2016). Virtual museums are one way to motivate potential visitors to come to a museum and attract young people (Döpker, Brockmann, & Stieglitz, 2013).but they are also used in educational practice from kindergarten to university (Fokides, & Sfakianou, 2017; Franceschi, & De Miguel Álvarez, 2021; Verde, & Valero, 2021) as they serve a multitude of cognitive, skill and behavioral goals (Dalari, 2017). Young users have the ability to discover stories and information behind the exhibits, interact with them, learn and have fun, understand concepts in depth, and improve memorization through images and 3D representations (Graf et al., 2015; Verde, & Valero, 2021).

Virtual museums as effective teaching tools support interdisciplinarity, innovation and STEAM methodology, emphasize the creation of social networks, offer new possibilities for interaction between teachers, students and educational staff of museums, thus improving cooperation between groups. The games and the simulations enhance active participation and critical thinking, improve students' cognitive and sensory skills as they are suitable for teaching complex concepts and successfully support holistic learning. The use of virtual museums in the educational process offers autonomy to the student, who can interact with the exhibits and learn on his own, discover details and activate digital learning skills (Franceschi, & De Miguel Álvarez, 2021).

2.3 Universal Design (UD) Principles of a Museum

The basic principles of building a museum are based upon the UD principles proposed by Mace, Hardie and Place in 1996 for accessible environments for elder and disabled people who claimed that building and exterior places should be accessible by anybody. These, in a few words are 1) equitable use, 2) flexibility in use, 3) simple and intuitive use, 4) perceptible information, 5) tolerance for error, 6) low physical effort, 7) size and space for approach and use (Mace, Graeme, & Jaine, 1996). These principles are not always applied in already existing museums (Filova, Rollova, & Ceresnova, 2022).

2.4 The Five E Instructional Model (5EIM)

The development of our project followed the 5E Instructional Model which consists of the following stages: 1. Engagement, where students and teacher ask questions related to real or open problems and students propose possible solutions after brainstorming, 2. Exploration, where they combine their knowledge on several fields to generate possible solutions, 3. Explanation, where they interpret several types of

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data and cooperatively evaluate solutions, 4. Elaboration/Extension where they pick a solution, implement it and create modifications for further investigation of the subject, 5. Evaluate the solution chosen working in groups and assess it (De Coito, 2016). The 5EIM was chosen as it has been shown to be successfully applicable in STEM (Science, Technology, Engineering and Mathematics) scenarios (Kotretsou & Kontogouri, 2021) and it was obvious from the beginning that our project involved at least Technology (i.e., ICT tools, platforms) and Mathematics (objects' proportions, dimensions).

3. About the Project

Since the year 2021 was the 200th anniversary of the Greek Revolution, the Public Historical Library of Andritsaina (PHLA) collaborated with the student network called "Wild Paintbrushes" to produce material based on the revolution and the work of some people who contributed to it. The inputs of the project are uploaded on a web page and are also placed in a virtual museum. Although the museum was generally designed according to designs of other schools, we kept in mind that its construction may one day take place in reality. So, in the details we tried to include as much of the above UD Principles we could: entrance with no steps, navigation help, multisensory information, no barriers, ergonomic solutions etc. The task of the 8th Senior High School of Peristeri, Greece, (member of the above-mentioned network) was to find an attractive for teen-agers way that the material produced by the projects carried out by the other schools would be accessible by anyone interested, now and in the future. The answer was to place the students' and teachers' work as exhibits into an attractive museum. For the students, the research question of the school's project was "How can we build an attractive for teen-agers virtual museum, in a way that it can resemble a traditional one?".

The inputs of the museum were based on the work of the cooperating schools and on the derivatives of events organized by the PHLA. Most of them (especially the photos and the PowerPoint presentations), took their final digitalized form by the students of the 8th Senior High School of Peristeri. Special attention was paid to the diversity of the exhibits, so as to attract people with a lot of different preferences. These inputs include: 1) videos, 2) creative writing texts based on manuscripts of the revolution, 3) poetry, 4) students' paintings 5) audio excerpts of reading poems and speeches, 6) information and photos from the folklore museum of Andritsaina, 7) interviews 8) photos 9) QRs that link to additional information, games (quizzes, puzzles etc.), digital books, and 10) 3-D objects.

All of the school students aged between 15-17 years old were informed of the project. Everyone was free to enter or leave the team. A whole class section of 19 students would participate in uploading material to a web page and creating QR codes. The main work of the creation of the museum was carried out by another team of five

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students from A and B class, differing in terms of: a) their familiarity with the computer games and PC applications (from gamers to those who used it mostly in school during the ICT lesson, b) their interests (some of them will follow classical studies and some will follow science) and c) in their school performance. None of them had previous experience on creating virtual museums or working on virtual environments. Other students who entered the team left when they realized how much work had to be done.

The main purpose is twofold: a) to investigate the benefits of building a museum with PowerPoint and ArtSteps, mainly targeting at 21st century skills acquisition, such as collaborating, making hypotheses, taking decisions, self-organization, persistence, patience, time management, learning tactics of problem solving, but above all to research, experiment, implement ideas and presenting the work done, skills that will later be useful in the professional career of the students and b) to propose ways of planning a museum taking into account accessibility. The objectives are that the students could become able to combine knowledge from seemingly different fields, be able to explain and support their ideas, accept better ideas, and assess their work.

The research method is a case study and regarding the intended scientific purpose, the research is interpretive, while in terms of the possibility of practical use of the results it is research action. As for the venue, it is laboratory since it takes place in IT laboratory and the PC as a learning tool. In terms of the number of people examined the research is qualitative as a number of school students participated in it.

4. Teaching Methodology

The teaching method was upon the principles of experiential, active and collaborative learning.

4.1 The First Stages (Engagement – Exploration – Explanation)

The problem was already generally defined but in order to become more specific, the following questions had to be answered: 1) What does a real typical museum look like? 2) How would we want our museum to look like?

To generate possible solutions, students searched the internet and made suggestions. They found that there are too many ways to build such a museum (Dalari, 2017; Nitsakis, 2020), for example Google Slides, Second Life, Open Simulator, Unity etc. but with a lot of differences between them.

To evaluate solutions and pick one of them, students had to answer the following questions: 1) What are the options we want the user to have?, 2) What types of exhibits will the museum house?, 3) What are the possible difficulties we are going to face?, 4) What options do we have in relation to our capabilities and the required and available study time?

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Students decided that the visitor should be able to determine the tour of the museum himself, which should simulate the actual movement in the space. Since they had in mind that the museum might be really build and that research has shown that virtual museums are already integrated in traditional ones (Döpker, Brockmann, & Stieglitz, 2013), they decided that they would like the visitors to use their mobile phones in order to enter AR environment for more information, by scanning QR codes.

For reasons explained below, students decided to use either PowerPoint or the free edition of Artsteps. Discussing the difficulties they were going to face, they decided to pick the most challenging and in line with their interests, so, they were encouraged to separate into two groups: one for PowerPoint (3 students) and one for Artsteps (two students). Both groups would build the museum based on the same model, but would decide for the details.

4.2 The Elaboration / Implementation Stage

4.2.1 Artsteps

On the Greek platform -already used for virtual museums worldwide- "Artsteps", someone can create 3D museums where a user can have a tour, either on his own or following a predetermined from the creator path. Students liked the idea that later on they might have the opportunity to wear the special glasses for a real VR experience. They also found it interesting in matters of accessibility that it has an app for mobile phones and this was deemed important as many applications now focus on virtual museums via mobile devices (Graf et al., 2015). They watched tutorial videos only after experimenting on their own and still face difficulties. When they felt they knew the platform quite well, which happened very soon (at the second meeting of that stage), they started building the museum based on the model. Before uploading the exhibits, they had to photograph some of them and edit the pictures to remove the background. They experimented on several ICT tools for this, such as windows Painting, Free Image Background Remover (Adobe Express) and Online PNG Tools which they used most. Taking the photos and removing the background was time consuming (3 months) and all members of both teams were occupied with that task. They also used PowerPoint to create labels and signs to use them in Artsteps.

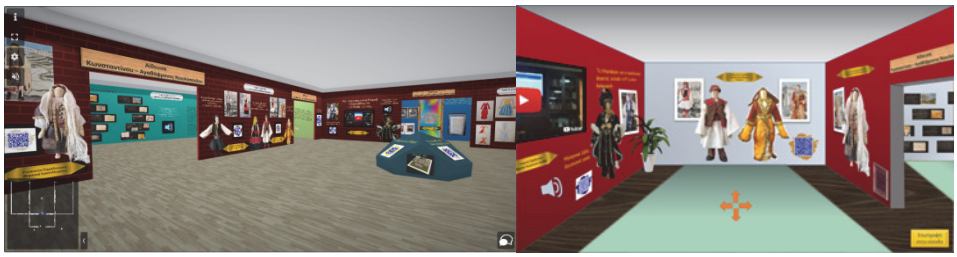

Fig 1. *Rooms of the museum in Artsteps (left) and Powerpoint (right)*

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A problem they faced was how to create their own 3D objects and place them into the museum. Solving this particular problem was deemed important because use of 3D objects in a visual museum, not only makes it more interesting, but it can also give us important data for documentation and visualization (Tota, Shehi, & Onuzi, 2017). The group asked for external help, but the teacher also taught them Tinkercad. There were also problems with the school computers that were very slow for the platform and we had to carry our own laptops at school. The students' work in Artsteps is available on https://www.artsteps.com/view/628f7b3b78c00f4a5f9ae2d7.

4.2.2 PowerPoint

On YouTube there are a lot of videos about how to create a virtual museum with Google slides and free templates are offered for this purpose. One can move between rooms by clicking arrows, upload exhibits amongst others and give extra information by linking to other slides. Since students wanted to create their museum based on a certain design, housing only their own exhibits and giving the impression of moving like 'browsing the google maps using street view' (as they said), these templates could not be used. It was clear to them though, that if they learned the PowerPoint tools, they could create a museum that would be like those offered by Google slides. The PowerPoint has already been used from other schools (Efstathiou, 2016), but we did not find any that uses this "like the street view movement". They were very interested in this because they found it would be attractive for the users.

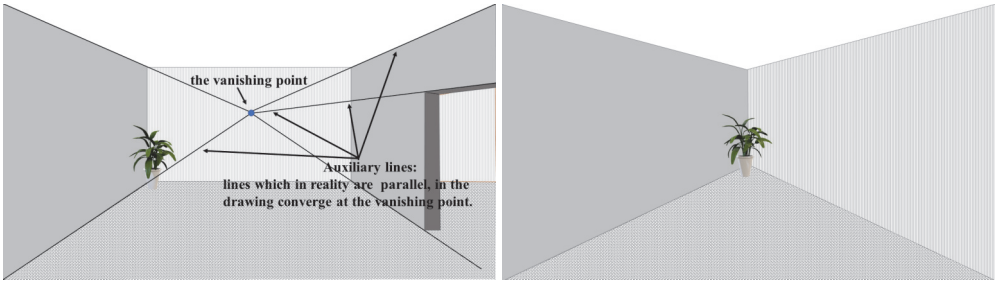

Fig 2. *Lines converging to the vanishing point are used as guidelines for the design of the walls, floor and ceiling in order to give the impression of depth (left). One of the intermediate slides used to give the impression of turning (right).*

They first started by designing a room. They learned to give the sense of depth by using the vanishing point, how to use the colors and the textures and how to use grids and rulers so as to be accurate in their designs. Moving forward and backwards was not difficult, since there is a zoom tool for this. To solve the problem of turning around they had to find out a way to make an object seem moving. They started experimenting in real classroom about how it could be done but it was not easy. Since they knew that the Scratch cat seems like walking only by changing the two "costumes" that the sprite has, they decided to use slides with the initial and final

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position of the wall, inserting some intermediate positions in a certain order. To find the way that the room would look like in the intermediate position, they used Artsteps. They used auxiliary lines on which the ends of the sides of the wall moved. Students in this team also worked with the other team in cutting the photos. For the other rooms and movements they copied the slides they already made, but placing the artifacts was not easy, because they should make them look like turned in the side walls in every intermediate phase of turning. The slides used for turnings increased the size of the file too much because of the too many artifacts in each one and the insertion of slides used for hyperlinks for more information, increased it even more.

4.3 The Final Stage-Assessment

The assessment stage was done through the teacher's reflection journals kept during the whole project and a semi-structured interview of the five students of both groups. The students of both groups were also asked to collaborate in writing a text on what they gained in terms of knowledge, skills and life attitudes. A subjective assessment of the degree of achievement of the goal was also made as well as a comparison between the two methods. 20 students with previous experience in navigating in virtual worlds (through video games) and 25 other students and elders with no such previous experience were asked to navigate in the museums and answer some questions presented below.

5. Results

During the assessment stage there has been a comparison between the two solutions.

Students found that the free edition of Artsteps was easier in building they had difficulty in placing the exhibits exactly where they wanted, mostly with 3D objects. Artsteps was much easier in turning while in PowerPoint it was difficult since in every intermediate step the shape of the exhibits had to be modified too. The PowerPoint team faced difficulties with time management, the artifacts' perspective and with the multitude of tools they had to learn.

As recorded in the reflection journals kept by the teacher and in the semi-structured interviews, students of both teams acquired knowledge of using ICT tools that were not taught in school. Students had no previous experience in creating anything in a virtual world, despite the fact that it is in their curriculum. Surprised by that, and even though it was out of the purpose of our project, we asked 5 IT teachers who said that they teach it only on theoretical basis because the school PCs cannot support it, which was also ascertained by us. Of course, we cannot claim this applies to other schools, since the sample is too small.

Concerning the obstacles, the main one was the low specifications of the PCs of the school's IT laboratory. But all the members of the teams could work on any other

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problem they faced an overcome it, such as to find extra needed free software, to find a place to use as a repository where only the teachers and the team would have access and ability to edit the files (they used google drive) and to use objects free of copyright (they created their own), make the turning movement on PowerPoint etc.

Students rated themselves on whether they developed or improved 21st century skills, on a scale of 1-5, where 1 corresponds to the minimum score and 5 to the maximum. In Table I we can see the average grade each team gave to the acquisition and development of 21st century skills, as well as the overall average.

Table 1. *Grading the acquisition of 21st Century Skills*

skill	PowerPoint team	Artsteps team	Total average
Team work	4,33	4,5	4,4
Cooperation	4,33	4,5	4,4
Communication	3,33	3,5	3,4
Being coordinated with the team	3,33	4	3,6
Coordinating the team	4	4,5	4,2
Organizing	4,33	3,5	4
Accept	4,33	4	4,2
Respect	4,33	4	4,2
Support opinion	5	4	4,5
Learn how to learn	4,67	4,5	4,6
Critical thinking	4,33	4,5	4,4
Creativity	4	4	4
Time management	4	3,5	3,8
Problem solving	4,33	4,5	4,4
Interdisciplinarity	4,67	4	4,4
Social empathy	3,33	4	3,6
ICT	5	5	5
Awareness on history issues	4	3,5	3,8

To the question “What do you consider the most important of what you gained through the program? Why;” all of the students emphasized the development of skills of working in teams, cooperation and coordination. The four out of five believe that this will be useful in the future. Three of them stated that they now know the way of forming new and strong friendships. To the question “Do you think that the knowledge you have gained will be useful for your studies or for your professional career? In what way;”, they all answered affirmatively stating though that this does not only concern knowledge on ICT tools.

From the answers we took from the question “Would you like to add anything?”, students mentioned that they learned about the fashion of that era and that they were

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interested in the technics used by the other schools to make the exhibits. We will keep those phrases: “I believe that everyone should try things and grab the opportunities that are presented to them because no knowledge is wasted and once the opportunity is there to take advantage of it.”, “…we were given the opportunity and time to get to know each other and I am very happy and grateful to have such good people around me, both inside and outside the school premises”, “…I learned to meet deadlines and strive for the best possible result.” From all the above we can assume that results in both teams were almost the same.

Since one of our purposes was the accessibility of the museum, we published the museum we made in Artsteps, we sent the link through the competent educational institutions to all the schools of our country, we gave all teachers free license to use it in the educational process and asked for feedback. In less than 20 days we had more than 600 views with an increasing rate and we received very positive comments about the suitability of the material for use in the educational process, referring not only to its quality, but also to its diversity. We also asked 25 other people with no experience in navigation to AR/VR worlds to navigate in it and asked about their opinion. They noticed that it is designed for people who have different preferences from each other (reading texts, listening to audio clips, watching videos, playing games, interested in paintings etc.) and that they had access to it also through their mobile phone. All of them faced difficulties with the movement in the museum and needed help or instructions. 18 of them claimed to have a headache or felt dizzy after 20 minutes in the museum in Artsteps, but not in Powerpoint. None of the students in school who tried Artsteps (20) and had previous experience in video games faced any problem. All of the people who visited the museums find the environment attractive.

6. Conclusions - Discussion - Proposals For Future Work

As this is a case study and not a generalized survey, we cannot claim that the results can be generalized, although there is strong evidence that this is the case. As recorded by all of the students, the purpose and the objectives of the project were achieved in a very high degree, as well as many more, worth mentioning the better knowledge of ICT tools. The benefits for the students are in accordance with previous research (Efstathiou, 2016; Fokides & Sfakianou, 2017), but it should be emphasized that despite the fact that the work of the students concerned only the creation of the museum and the placement of the exhibits and not the study of them, however, history topics were spontaneously discussed students’ awareness on cultural heritage issues was raised. Taking into account that even though the exams had finished, the students arranged meetings to finish the project, we can also assume that their involvement with the project was very high. They claimed that their need to learn about technology and cultural heritage issues increased and thus laid a stronger foundation for their multifaceted personality development as we can conclude. The results give a clear affirmative answer to the question if the creation of a virtual

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museum is suitable for achieving the goal of developing students 21st century skills. They also give an answer of how to plan a museum taking into account accessibility: multiple representation of the artifacts, use more than one senses and accessibility through different kind of devices.

It is worth mentioning that most of the solutions to the difficulties were found by the students themselves through the great support they provided each other. So, considering also the fact that all goals were achieved, the views of other researchers are confirmed, who claim that providing students with a high degree of autonomy can lead to good performance (Hong, McGee, & Howard, 2000). Our findings are also in line with those of other studies, as we found that despite the many advantages that a virtual museum presents, there are also disadvantages. People who do not have basic computer knowledge find it difficult to navigate in the virtual museums (Katz, & Halpern, 2015).

Artsteps has the potentiality of easily changing or adding exhibits and generally building or editing the museum. Our results are in line with research that shows that through Artsteps the transformation of knowledge is achieved in a playful way, with the help of a medium that is familiar to students, close to their interests, easy to use and attractive and that it offers variety, liveliness and pleasant teaching atmosphere (Fokides & Sfakianou, 2017). But, the results come in contradiction to research claiming that an interesting AR/VR application should have short development time and a small number of individuals involved (Zouboula, Fokides & Tsolakidis, 2008), since the application had for long development time. Also, our small research cannot confirm other research that claims that Artsteps can be easy accessed by computers in schools allowing complex activities and tasks (Fokides & Sfakianou, 2017), we found that not only in our school, but also in others (a small sample) computers cannot support such environments and we had to use our personal computers. Understanding reality on the basis of virtual reality technologies classifies the formation of relevant skills of students as urgent (Atamuratov, 2020). Since not only building but also entering a virtual world, the devises you use must meet certain specifications, it might be interesting to investigate whether computers in school laboratories can meet the demands of a modern computer science course.

Several studies indicate the connection between visual arts and virtual reality environments, such as Second Life (De Coito, 2016), stressing the fact that teachers have the opportunity to use ICT for engaging and motivating students, as well as for encouraging cooperation between them (Efstathiou, 2016). In several teaching subjects, teachers use virtual museums as alternative learning environments. A virtual museum created by students can benefit students to come, since it can be used for teaching history, art and other lessons to them. After all, a virtual museum is definitely a VLE (Virtual Learning Environment), as it is an educational place for its visitors and even more so when it is designed with emphasis on the most efficient possibility of learning through it (Nitsakis, 2020), and allows innovative didactics

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because it offers new learning and teaching opportunities (Atamuratov, 2020; Verde, & Valero, 2021).

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Περίληψη

Αυτό το άρθρο ασχολείται με τη εργασία μαθητών για τη δημιουργία ενός εικονικού μουσείου βασισμένου σε δοθείσα μακέτα. Το μουσείο δημιουργήθηκε στην πλατφόρμα Artsteps και στο PowerPoint. Γίνεται αναφορά στη μεταξύ τους σύγκριση. Οι μαθητές, χρησιμοποιώντας οπτικές ψευδαισθήσεις, έδωσαν στον επισκέπτη του μουσείου στο PowerPoint τη δυνατότητα να πλοηγηθεί όπως στο Artsteps. Διερευνήθηκε η επίτευξη γνωστικών στόχων, δεξιοτήτων και στάσεων. Στο άρθρο παρουσιάζονται επίσης οι δυσκολίες που αντιμετώπισαν οι μαθητές και οι λύσεις που βρήκαν. Η όλη διαδικασία βασίστηκε στο Εκπαιδευτικό Μοντέλο των 5 Ε σταδίων και οι μαθητές ωφελήθηκαν πολλαπλώς, όχι μόνο κατακτώντας τους προκαθορισμένους στόχους, αλλά και διότι μέσω της προσπάθειας επίτευξης κοινού στόχου χτίστηκε μια ισχυρή σχέση μεταξύ τους, αυξήθηκαν η ανάγκη τους να μάθουν για θέματα τεχνολογίας και πολιτιστικής κληρονομιάς και τέθηκαν ισχυρά θεμέλια για την πολύπλευρη ανάπτυξη της προσωπικότητά τους.

Λέξεις κλειδιά: Artsteps, Εικονικό Μουσείο, 5E Instructional Model, PowerPoint.

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