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Article

From paper to virtual: The meta-life of a historical cartographic artifact

Kostas Diamantis[1], Vasiliki Gerontopoulou[2,*], Maria Pazarli[3]

[1] 3D Graphics and Game Developer, Kosmad 3D Studios, 11141 Athens, Greece
[2] Onassis Library, Onassis Foundation, 10558 Athens, Greece
[3] General State Archives of Greece-Cartographic Heritage Archives, 54633 Thessaloniki, Greece
*** Corresponding author:** Vasiliki Gerontopoulou, vgerontopoulou@onassis.org

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Abstract: The Charta of Rigas Velestinlis is one of the most important works of the eighteenth-century Neo-Hellenic Enlightenment and the most characteristic sample of Greek scholar cartography. Printed in Vienna in 1220 copies in 1796-1797, this emblematic map of the Balkan peninsula significantly influenced the development of ideas and perspectives that inspired the Greek War of Independence from the Ottoman Empire in 1821. The sixty (60) known remaining copies of this valuable material in Greece and abroad remain stored in the confined spaces of libraries, museums, and archives, strictly guarded for security, conservation, and preservation. This renders their access difficult to both the general public and the educational community. Since the Onassis Library and the General State Archives of Greece—Cartographic Heritage Archives both possess an original copy of this historical document each, they design and implement many educational programs aiming at highlighting its importance and reintroducing it to the public. This paper will present how the usage of new technologies, both in software and hardware, has facilitated the showcasing of cultural heritage artifacts, such as Rigas' Charta, with an emphasis on technologies and resources that are freely available to everyone. It will also be demonstrated how the digitization projects, the digital libraries, repositories, and platforms implemented by many cultural and research organizations during the last decade, presented the opportunity for the new generation to come in contact with a variety of "locked away" historical documents, like Rigas' Charta, allowing their reuse and reinterpretation while providing unlimited potential for the collection, research and presentation of facts, evidence and data. Furthermore, the incorporation of this digital cultural wealth in the school curriculum through targeted educational programs and the creative combination with open-source metaverse development tools, unleashed the possibilities of reviving the past, extending the life span of old materials to perpetuity. As a result, this multimodal approach paved the way for the emergence of a new more democratic, open-access, and inclusive educational model.

Keywords: Rigas' Charta; Augmented Reality; Virtual Reality; 3D VideoGame; digital storytelling; cultural heritage; educational change; educational innovation; open access; inclusiveness; metaverse educational tools

1. Introduction

The Onassis Library is a special library that aims to accumulate both physical and digital collections of old books, archives, artworks, and historical documents (old maps, atlases, travel books, geographical editions), providing an excellent source of materials for the creation of educational activities involving historical themes and rare objects in the learning process. Striving for excellence, seeking collaborations with renowned research and educational institutions while combining new technological approaches to historical research, the Onassis Library is an inexhaustible source of

inspiration, encouraging curiosity, discovery, and playfulness alongside critical thinking through its educational programs.

However, the aim to contribute to the preservation of the cultural wealth of Greece and safeguard it with respect can be hindered, since its survival depends on more factors apart from the obvious ones of its protection and maintenance. The risk of permanently losing its impact persists if the knowledge embedded within is not preserved and passed on to future generations. A deep concern, therefore, regards the means to transfer this wealth to the new generation, on how to unlock the closed boxes and locked cabinets containing all of this knowledge to make it accessible to everyone. No library should become a warehouse or a burial ground for books or exhibits. It is therefore essential to liberate the spirit and ideas that have been imprisoned within its material for centuries, to unleash the hidden potential to be embraced and inspire society.

In line with this objective, the Onassis Foundation has undertaken the digitization process of all of its collections, making them also freely accessible to the public. Originally conceived as a rescue project for rare artifacts, the digitization effort aims to breathe new life into these materials, inspiring the youth through creative interpretations, and rediscovering the treasures embedded in the Greek intellectual tradition. It also seeks to unveil hidden interpretive commentary within well-known classics and bring historical sources and important works closer to students, researchers, and the general public, leveraging technology and the internet. This mission was mainly accomplished through the permanent investment in new technologies. This digital transformation allowed for the reinterpretation of historical evidence and primary sources, expanding their social and educational benefits and motivating young people to foster bridges of dialogue, filling the gap with the past and preparing them to face the technological challenges of the future.

During the past ten years, many cultural and research organizations participated in national and European co-funded programs that allowed them to digitalize their cultural wealth and promote it on the World Wide Web through various digital platforms, repositories, databases, websites, and applications. Emerging technologies present significant opportunities to enhance accessibility to our shared cultural heritage. Embracing these possibilities requires the adjustment of our communication methods, particularly when engaging with the public, and more specifically, the young generation. Through the utilization of these new technologies, individuals, regardless of their geographical distance, and economic or social status, now can access this rare material. They can make it their property, reuse it, study it, and contribute to its further development and existence.

Although the use of Information and Communications Technology (ICT) in education plays a fundamental role in implementing meaningful learning approaches, the reality is that there are still insufficiencies to achieve this, as teachers are unaware of the ICT tools available to fully support this type of learning for their students. In addition, the majority of the educational community ignores that a large part of the digital content created by renowned organizations can be easily incorporated into the school curriculum and is open for access to all. There is little training for these teaching professionals on the methods and ways to tackle this task, as well as insufficient

resources from their respective administrations to put them into practice in the classroom.

Taking all the above into account, a historical cartographic document of the eighteenth century, Rigas' Charta, was selected, and a series of educational programs were designed to highlight its importance and motivate young people to further acquaint themselves with it and create niche projects inspired by its hidden stories and symbols. This innovative educational experience managed to offer a meta-life to this artifact, promoting educational equity and bridging the gap between geographic, social, and economic constraints that limit access to great opportunities. Moreover, digital transformation and the use of distance synchronous and asynchronous learning contributed to the reduction of discrimination and enhanced participation of various individuals all over the world.

Rigas' Charta served as a best practice in managing and promoting important cartographic material, transforming it into an attractive object for the educational community and the general public, accentuating its timeless significance, and ensuring its enduring legacy for future generations. By applying Object-Based Learning (OBL), Game-Based Learning (GBL), and Project-Based Learning (PBL) methodologies, the artifact was presented in a comprehensible and modern way via metaverse development tools, setting the basis for the establishment of a new educational model and leading to a deeper understanding of our cultural heritage.

2. The Rigas Velestinlis' Charta (map) of Greece (Vienna, 1796–1797)

The Charta of Rigas Velestinlis is one of the most important works of the eighteenth-century Neo-Hellenic Enlightenment and the most characteristic sample of Greek cartography of the pre-revolutionary period [1]. Crafted by the renowned engraver Franz Müller and printed in Vienna (1796–1797) in 1220 copies, the Charta was part of Rigas's revolutionary strategy against the Sultan's tyrannical control over the enslaved Greeks and other Balkan peoples. The map allegedly depicted Ancient Greece, following the European tradition of scholar cartography, while in fact illustrating the vision of a democratic state in the area, following the realization of its creator's revolutionary plan [2] influenced by the radical ideas of the French Revolution and the European Enlightenment. It consists of twelve (12) folios measuring approximately 50 cm × 70 cm each, which, combined, form a monumental 2 m × 2 m map that inspired the Greek Revolution of 1821 [3,4].

Rigas intentionally incorporated in his map symbols such as scenes from everyday life in ancient Greece, 162 ancient Greek, Roman, and medieval coins, more than 5800 toponyms, archeological monuments, mythical heroes, comments, historical battles, and topographic drawings, derived from the rich classical and European cartographic and literary tradition, mainly of French origin [5,6]. All these iconographic elements supported Rigas' vision for the establishment of a free democratic state in the Balkan Peninsula, based on the ideas of freedom, justice, and equality, and reflected the historical continuity of Greek culture and civilization from antiquity to the eighteenth century. The use of symbols incorporates an incredible communicative power, aiming at the awakening of the national identity of the Greeks

and all the enslaved people in the Balkans; that is why the Charta has been characterized as the "multimedia" of another era [6]. Therefore, it was deemed the ideal conduit for using metaverse technologies to enhance and distribute the information drawn on the map, reaching new levels of interaction, presentation, and audience reach than ever before, conveying the purpose of the Charta to the modern age. Besides its value as a revolutionary item, Charta's educational aspect is also of great importance, since it was intended to be used as supportive educational material, reflecting its creator's innovative ideas on high-order quality education provided for free in Greek schools in the Ottoman Empire and Europe [1].

Today, there are only sixty (60) surviving copies of this historical map, scattered around the world, in major Galleries, Libraries, Archives, Map-libraries, and private collections. The Onassis Library and the Central Services of General State Archives of Greece both have a full copy of the 12-page Charta each. Such important historical objects have the ability to inspire and transmit information, enthusiasm, and knowledge creatively through interaction and observation, enhancing memory and becoming catalysts for discussions and further quests. However, even though Rigas is widely considered a precursor of freedom and his literary works are well known within the Greek tradition, the Greek school textbooks contain few references to the Charta and most people are unaware of the connection of this map with Rigas' life and death or with his actions and revolutionary ideas, such as the aim for the creation of a radical free Republic in the Balkans. Moreover, access to the physical copy of Rigas' Charta is rather difficult, as it is not often displayed, and it is usually stored in private library rooms and exclusive spaces. As a result, a limited number of people have seen, touched, or even studied one of the few surviving physical copies of Rigas' Charta.

As this map is one of the main exhibits of the Onassis Library and the General State Archives, its secret symbols and stories soon became the source of inspiration for a series of educational activities [7,8] involving this historical document, transmitting its liberating messages and extending its life span through advanced technological tools.

3. Theoretical frame

Object-Based Learning (OBL) is an educational approach that actively involves students in the utilization of genuine or replicated material objects, integrating them into the learning environment [9,10]. This method promotes analysis and critical reflection [11], fostering communication, teamwork, and critical thinking. Rigas' Charta, being a significant historical document, has the potential to inspire, inform, captivate, and motivate students, resulting in a lasting impact on memory [12]. This impact is heightened and transformed into a unique experience when combined with game-based learning (GBL) and project-based learning (PBL), encouraging participants to acquire knowledge and skills in subjects traditionally considered "difficult", tedious, or even boring [13]. Project-Based Learning (PBL) is an instructional approach that aims to foster intellectual development, collaborative skills, innovative problem-solving, and a genuine enthusiasm for learning. Meanwhile, Game-Based Learning methodology (GBL) successfully alters user behavior to

complete tasks more enjoyably, simultaneously promoting increased participation and commitment [14].

Considering the above theoretical framework, it was decided to blend Object-Based Learning (OBL), Project-Based Learning (PBL), and Game-Based Learning (GBL) methodologies, incorporating metaverse multisensory technological tools (Virtual and Augmented Reality technologies, 3D VideoGame creation tools and Digital Storytelling multimedia techniques) as well as synchronous and asynchronous distance learning methods (digital platforms, collaboration suites, etc.) in order to design educational activities inspired by the emblematic artifact of Rigas' Charta.

4. The educational programs on Rigas' Charta

4.1. The pedagogical and cultural aim

The main objectives of all the educational programs on Rigas' Charta were to highlight this great historical document, to bring it to life and to motivate the new generation to decipher its secret messages with the help of advanced digital technologies. The participants were encouraged to:

a) Get to know the life and work of Rigas Velestinlis.
b) Recognize the secret messages and symbols engraved on the map.
c) Utilize archival material in the educational process.
d) Creatively combine history, geography, cartography, visual arts, and information technology to create digital projects regarding this cartographic item.
e) Conduct historical research and get in touch with primary sources, old maps, and archival material.
f) Collaborate in a creative way through the different cognitive objects.
g) Get acquainted with innovative digital tools, acquire digital skills, and become creators of technology.
h) Visualize an idea by using new digital technologies and good communication practices.
i) Revitalize old documents and offer them a meta-life for the readers of the future.
j) Learn how to protect, conserve, and preserve old documents and archives.
k) Familiarize with best practices, policies, and terms of use applicable to digital materials and objects.
l) Enhance the sustainability and resilience of both Archives and Libraries by creating new enthusiastic users among the educational community.

4.2. AR application "Rigas' Charta" (Google Play) [15]

In order to enhance the experience of the on-site visitors at the Onassis Library in regards to the physical exhibit of Rigas' Charta, an early idea came to fruition with the development of an Augmented Reality application that would accompany the artifact in the form of an exploration tool that would trigger the visitors to focus on and investigate the hidden messages depicted across the twelve pages of the map. Starting with the symbol of the sleeping lion that would wake up and come to life and a narration that would explain its metaphoric connection to the enslaved Greek nation, more and more symbols were added, gradually enriching the experience. Seeing the

overwhelming response of the public interacting with the artifact, it was decided to take it a step further and make the application available to a wider audience, outside of the closed walls of the library, and through the Google Play app store entitled "Rigas' Charta"[1] (**Figure 1**) as a free educational application that enhances the viewing experience of any copy of the Charta.

The perfect opportunity presented itself with the publication of a children's book[2] narrating the tales of a young Rigas, which was accompanied by a downscaled version of Rigas' Charta to help further distribute the application to a wider audience than before and use it in conjunction with a physical printed copy of the map. The reader could use an Android device and navigate the map, through which fifteen (15) symbols would come to life. The application operates on all map variations, physical and digital ones, encouraging the users to discover symbols such as:

1) 162 ancient and medieval coins;
2) Jason and the 'Argo';
3) Hercules and the Amazon;
4) The ancient Greek theater;
5) Ancient Olympia and the Olympic games;
6) The Oracle of Delphi;
7) The Colossus of Rhodes (**Figure 1**);
8) Pyrrha and Deucalion;
9) The female emblematic figure on the forehead of the Charta;
10) Hero and Leander;
11) The battle of Plataeae;
12) The naval battle of Salamis;
13) The battle of Thermopylae;
14) The sleeping lion;
15) The Wind Rose.

Figure 1. The symbol of the Colossus of Rhodes augmented with "Rigas' Charta" Android application.

After gathering all the necessary material for the symbols, a scene was created for each, matching closely the related imagery of the Charta. The 3D models were created, textured, and animated within the 3Ds Max software; they were optimized in geometry and textures as much as possible in order to run smoothly on most mobile devices. They were then exported to the Unity 3D Game engine and set up within it with in-game materials, environment, effects, and code. Each symbol of the Charta would serve as a trigger point that would activate a 3D scene with the use of Augmented Reality, and a story about that element would unfold. Through a hidden "treasure hunt" game, both readers and users participate in a fun interactive experience that creates images and feelings that remain long after the educational activity is over. The AR application was distinguished in the "DH AWARDS 2021"[3] as the 1st Runner-up in the "Best use of DH for fun" category.

4.3. Livestreaming guided tours at the Onassis Library [16,17]

During the pandemic, schools remained closed for a long time, lessons were delivered online, and educational excursions were not permitted. Under these difficult circumstances, the Onassis Library took the initiative with an online educational activity, providing teachers and students a way out of their routines, making the lesson more interesting. These interactive digital tours on the treasures of rare book collections, archives, and works of art managed to connect cultural heritage with education, enriching the history lesson, taking advantage of the inclusion, and giving the opportunity for equal participation of schools all over Greece.

The participants (schools, educators, students, parents) were connected live for the duration of a teaching hour (45') through an online platform (such as Zoom, WebEx or Teams) and actively participated in a "living documentary" unfolding unknown stories that could be generated in this manner, presented through a smartphone using a gimbal stabilizer. The program was conducted in English or Greek and there was also the possibility for interpretation in sign language upon request. Students of primary and secondary education had the opportunity to see incunabula and old books, to learn about the contribution of the invention of printing to the circulation of ideas during the Greek Revolution of 1821 and to get to know the story of Rigas Velestinlis and the role his Charta played in his life and death. The online tours were interactive, and participants could discuss and ask questions about the Onassis Library exhibits. The educational program was completed with online games, digital applications (Rigas' Charta app) and quizzes implemented with the kahoot.com online platform.

During the years 2020–2023, the aforementioned online activity was implemented in over 350 primary and secondary school units, as well as in special schools from all over Greece (cities, villages, islands) (**Figure 2**) and abroad (Greek schools in Europe and the UK), involving over 7500 students and their teachers. The great success of this educational program led to the decision to continue its online format even after the pandemic, promoting equal access to the same opportunities for all, contributing to the elimination of discrimination and inequality in education while demonstrating a good example of open access to knowledge that could also be adopted by other cultural organizations, museums, archives, and libraries.

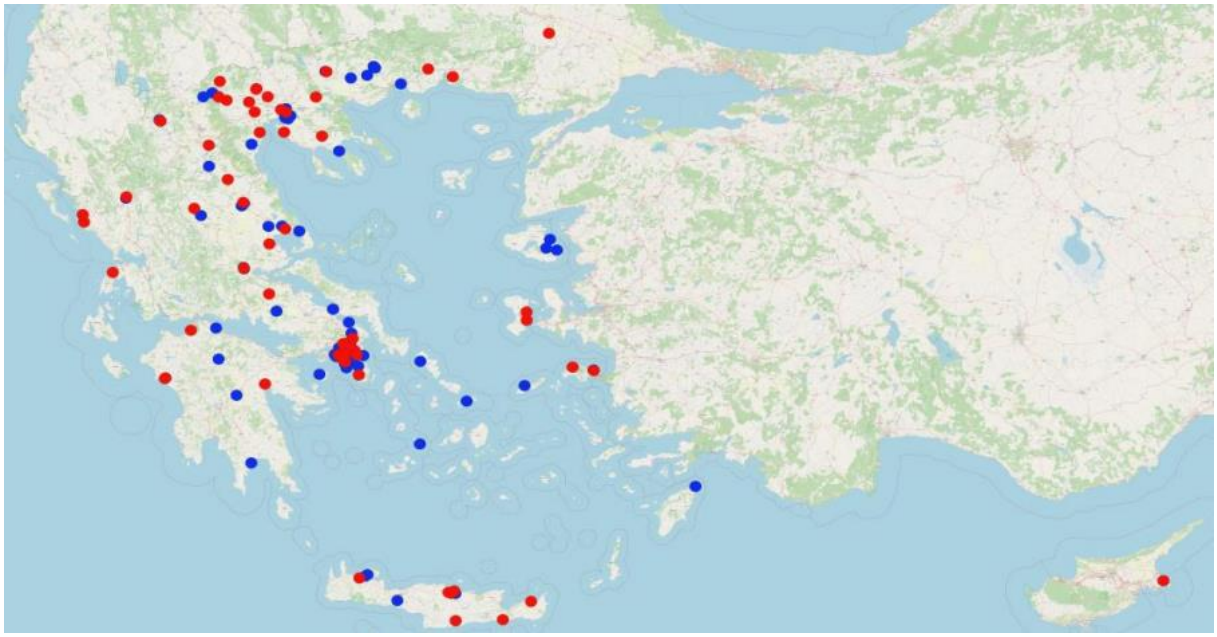


Figure 2. Primary (red) and secondary (blue) schools in Greece and Cyprus where the educational program was implemented.

This project started in January 2020 and has continued its course until now. The technical equipment needed for the schools would include a broadband connection, a digital collaboration suite (Zoom, WebEx, teams, Google meet, etc.), a laptop/PC, a video projector, a white screen/TV, a microphone, speakers, and a camera (optional). The technical equipment needed for the organizers would consist of a broadband connection, a matching digital collaboration suite account, a mobile phone with dual cameras, a gimbal stabilizer selfie stick, a microphone and speakers or headphones[4].

4.4. The Panhellenic student competition "Hack the Map: Rigas' Charta" [18,19]

During the school year 2020–2021, the Onassis Library designed a National Student Competition entitled "Hack the Map: Rigas' Charta". The competition was conducted entirely digitally in collaboration with the Cartographic Heritage Archives of the General State Archives and the Department of Geography of the Harokopio University. Inspired by Rigas' Charta, secondary school students from Greek schools in Greece and abroad, led by one or more teachers, were invited to combine historical and cartographic documents with new digital technologies and create Augmented and Virtual Reality applications, Digital Storytelling projects and 3D video games for PC and Android devices.

In the context of the digital competition, school teams were invited to create and submit one of the following digital works:

1) An AR application, displaying in a 3D form one or more of the elements of the map,
2) A VR application, creating in 3D at least one scene related to the map,
3) A Digital narrative regarding the myths or symbols presented on the map,
4) A 3D VideoGame drawing inspiration from the map.

To complete their projects, the school teams were strongly encouraged to utilize freeware and open-source software, or any online tools designated for educational purposes. This educational endeavor played a pivotal role in nurturing diverse digital skills among participants, introducing them to innovative digital tools and methodologies (OBL, GBL, PBL).

Participation in the competition involved forty-four (44) school teams (Phase A), comprising approximately 1150 students and their educators. Amongst the 44 submitted proposals, 21 were from private schools and 23 from public ones. 15 derived from Lyceums, 28 from Gymnasiums and there was also one proposal from a SVEL (Special Vocational Education Laboratory). In addition, 3 entries originated from abroad (USA, Germany, Ethiopia), 18 from Athens, 2 from Piraeus, 6 from Thessaloniki and the rest from 14 cities from all of Greece: Aigio, Arta, Volos, Giannitsa, Evia, Ioannina, Kavala, Katerini, Kozani, Larissa, Mytilene, Nafpaktos, Patras, and Crete. As for the categories of the digital works, those were the following: a) VR = 1 entry; b) AR = 8 entries; c) Digital Storytelling = 20 entries; d) 3D Video Game = 15 entries.

The Evaluation Committee of the Competition assessed the submitted proposals in February 2021, leading to the selection of 30 school teams to advance to Phase B for the implementation of their digital projects. Teams that did not qualify for the second phase were still provided with the opportunity to proceed with their projects outside of the competition phase. Results of the initial phase were posted on the online Classroom platform. During Phase B, which spanned approximately 2.5 months, the participating school teams were required to prepare their deliverables for their digital projects, including final executable files, source files, a video capture (promo video) of their application, and an explanatory accompanying text. Submissions were made through the Classroom platform and the OneDrive cloud application.

Following the completion of Phase B, 27 digital projects were ultimately submitted from the shortlisted 30 proposals. Additionally, one submission from a school outside of the competition was received. Unfortunately, three school groups were unable to complete and submit their projects due to the challenges posed by the Covid-19 pandemic to the educational community. Despite these obstacles, the high percentage of active participation from school teams throughout the entire competition and the substantial involvement of students and teachers, considering the difficult conditions in Greek schools from January to May 2021, were noteworthy. All submitted digital projects stood out for their quality, cognitive depth, and pedagogical value, reflecting the dedicated effort, perseverance, and interest of both students and teachers working collaboratively to achieve such excellent results.

All school teams creatively integrated ICT with history, geography, cartography, museology, and visual arts. They underwent the process of conducting historical research, familiarized themselves with essential elements of the Greek cultural heritage, explored the iconographic wealth of a historical map, and experienced distance learning. This immersive experience equipped them with functional, structural, and strategic skill sets that could prove valuable in their future careers [20].

The educational program, “Hack the Map: Rigas’ Charta”, stands as a notable example of digital literacy. It successfully fostered a creative integration of ICT with other subjects in the school curriculum, implementing both synchronous and

asynchronous online education. Ultimately, it evolved into an incubator for preparing a new generation of citizens to confront the challenges of a rapidly changing world. Funded by the Onassis Foundation, the student competition commenced in December 2020 and concluded in June 2021. Noteworthy digital school projects were awarded prizes for each category totaling 6000 euros and were uploaded on various websites[5] and social media platforms.

4.5. Classroom, an online open access Greek educational platform

Considering the challenges faced by the educational community during the Covid-19 pandemic, and with the aim of promoting participation in the competition, the Onassis Foundation introduced the Classroom platform[6], a comprehensive educational website accessible to all. Funded by the Onassis Foundation, the development of the educational platform began in May 2020 and was launched in December 2020. This open access repository gathers extensive educational content related to the Enlightenment era, Rigas' life and works, and various innovative initiatives implemented by the Onassis Foundation. It hosts free Moodle lessons that integrate history, geography, visual arts, and technology, featuring supporting materials, video tutorials, digital application scripts, presentations, bibliography, worksheets, high-definition digital copies of the Charta, and external resources. All these assets are provided in order to encourage, inspire, and support school teams in their projects. The Classroom platform became a valuable resource for online applications, enabling school teams to prepare for and participate in the student competitions organized by the Onassis Foundation every year. More importantly, the platform continues today to host all material even after each competition is concluded, remaining openly accessible to everyone.

In addition, the educational platform serves as a tool for distance learning, offering guidelines, useful scenarios, workshops on new technology, and template samples of digital projects such as the VR, AR, VideoGame and Digital Storytelling starter material archive packs [18]. It allows participants to ask questions, earn badges through gamification by watching educational videos, obtain certificates of participation, and provides a mechanism for students and teachers to give feedback and evaluate each competition they attended. The content of the digital platform is freely available to all visitors, continuously expanding with additional educational material each year.

4.6. Supporting educational material

Within the educational program's framework, the scientific collaborators and competition partners were dedicated to gathering all relevant supporting material related to the competition theme. This encompassed various elements such as video recordings, notes, optional scenarios, bibliography, digital exhibitions, editions, documentaries, references, and examples. Additionally, they crafted ten (10) Moodle lessons, providing comprehensive theoretical resources on Rigas' Charta and offering insightful case studies on the historical context, Rigas Velestinlis' revolutionary persona, the history of cartography, and more. These lessons were designed to facilitate further exploration and development by school teams. Through this curated

material, participants and readers were afforded the opportunity to delve into and draw inspiration from the stories and symbols associated with this heroic figure and his map. All of the supporting material was uploaded on the Classroom platform to be available to all.

With regards to the 2D and 3D digital content creation, a series of video tutorials were created in order to guide the participants throughout each project from start to finish. The videos were edited and sped up to capture the viewers' attention without being tiresome, and were divided into the following categories:

- A welcome, introductory video[7] explaining basic notions of 2D and 3D Graphics, Game Design and Development in order to familiarize the viewers with the upcoming content and key concepts. This was crucial in order to acquaint a new audience with a niche genre such as the Realtime 3D Graphics creation and the Videogame creation process.
- Step-by-step videos regarding the installation of all the necessary software required for content creation. Specific versions of the software were chosen in order to ensure stability and compatibility throughout the duration of the projects.
- Common content creation videos, for instance, would include methodology and techniques used to create 3D graphics that could be later implemented in either a competition project (VR, AR, VideoGame or Narration). To enhance variety and flexibility for the viewers, different projects were created in two of the most popular Game engines, the Unity 3D and Unreal Engine. All videos were accompanied by an archive of the related materials demonstrated and can be found freely available at the Onassis Classroom platform. More specifically, the videos currently available are as follows:
    - Basic geometry creation using TinkerCAD in order to create a 3D text. This video[8] (**Figure 3**) is intended to familiarize the viewer with the concept of a 3D software with the free, browser-based TinkerCAD without the need to install an application, while introducing the concepts of the camera view, the three axes (*X*, *Y*, *Z*), 3D navigation, etc. It also assisted in demonstrating the simplicity of a 3D text object creation in order to import it into a 3D Game engine.

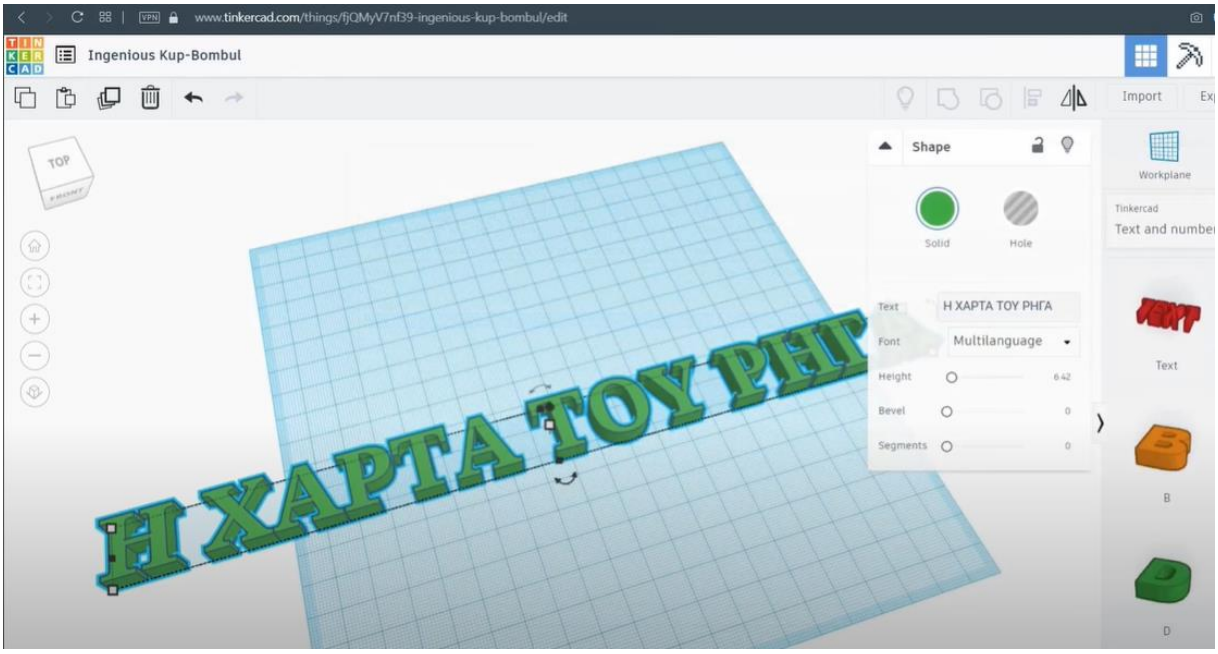


Figure 3. 3D text creation in TinkerCad.

- Geometry creation using TinkerCad in order to build a 3D Temple[9] (**Figure 4**). Following up on the concept, it is now demonstrated how to use primitive 3D shapes to form a 3D structure such as a temple. We then repeat the process of exporting the final model into a common 3D file format in order to use it in a 3D Game engine. The selection of repetitive actions (for example, each temple column creation) is on purpose as the repetition by nature helps with the familiarization of the process and memorization.

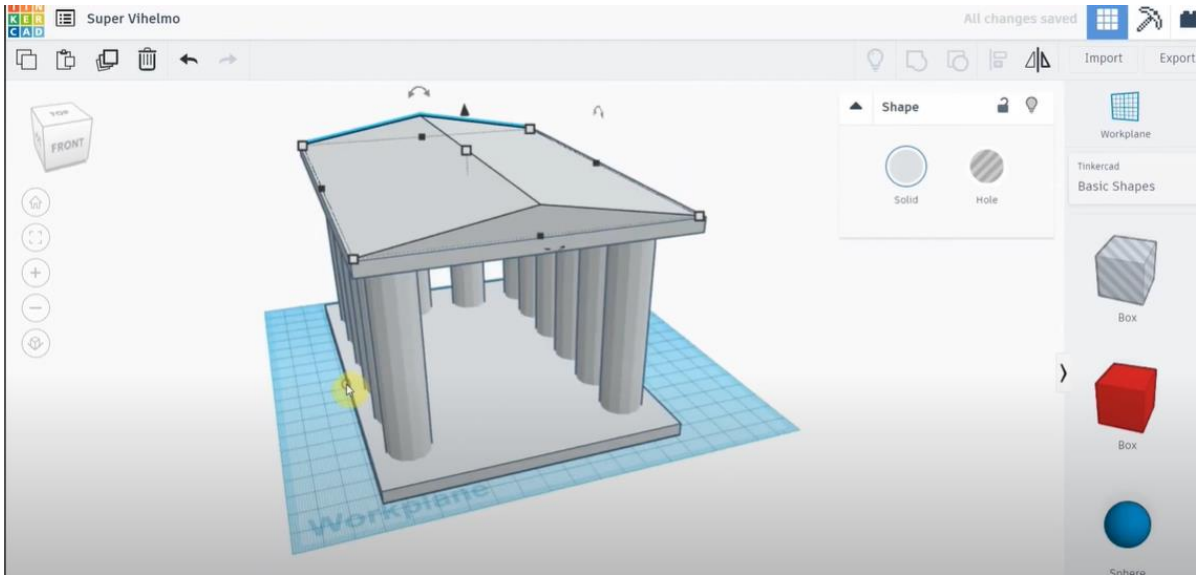


Figure 4. 3D temple creation in TinkerCad.

- Using browser-based image editing software Photopea to create a coin[10] (**Figure 5**). This free, online tool resembles the professional Adobe Photoshop software and is ideal for the introduction of the tools and

concepts that concern basic image editing skills. The resulting files can be used in all aspects of the related projects: 2D, 3D and video.

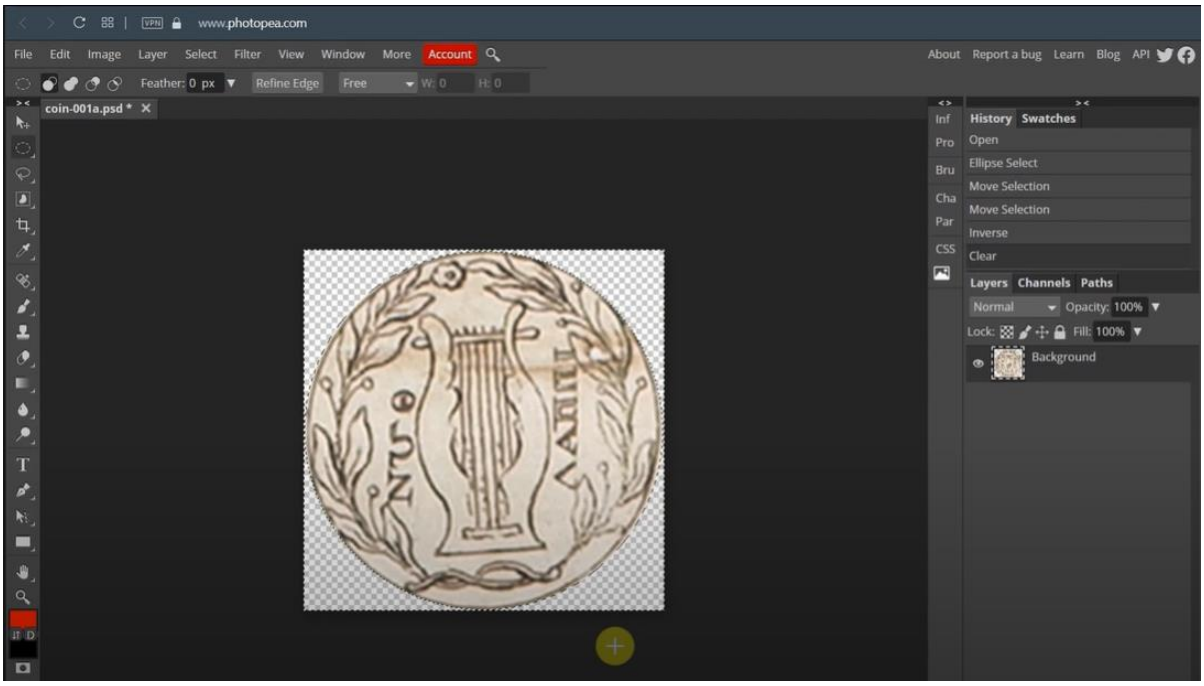


Figure 5. Creating a coin with transparency in Photopea.

- Simple 3D Character creation[11] using 3Ds Max Educational (**Figure 6**). This two-part video tutorial is intended to focus on a more advanced level of 3D content creation. The software used is one of the most popular 3D creation software amongst the gaming and VFX industries; therefore, an introduction to it could prove essential for the later career progression of a student interested in those fields. The subject of the videos is by itself more challenging, since it would require basic knowledge of anatomy, even to create a simple geometry model. Modeling creation and editing techniques were covered, advancing from primitive shape creation to modifying geometry, adding details, and working on a 3D mesh on a polygon and vertex level. Additionally, the concept of UVW mapping is introduced to the viewer, and how to achieve a UV unwrapping of a model to apply a diffuse texture with different colors for each region. To this end, the free image editing software GIMP was also used in order to demonstrate the texture creation logic and how to import the result back into the 3D creation software. Finally, the finished model is then exported to a common 3D model format (FBX) and it is demonstrated how it can be easily animated with preset motion capture animation files provided by the online archive of Adobe Mixamo to be later implemented into a 3D Game engine.

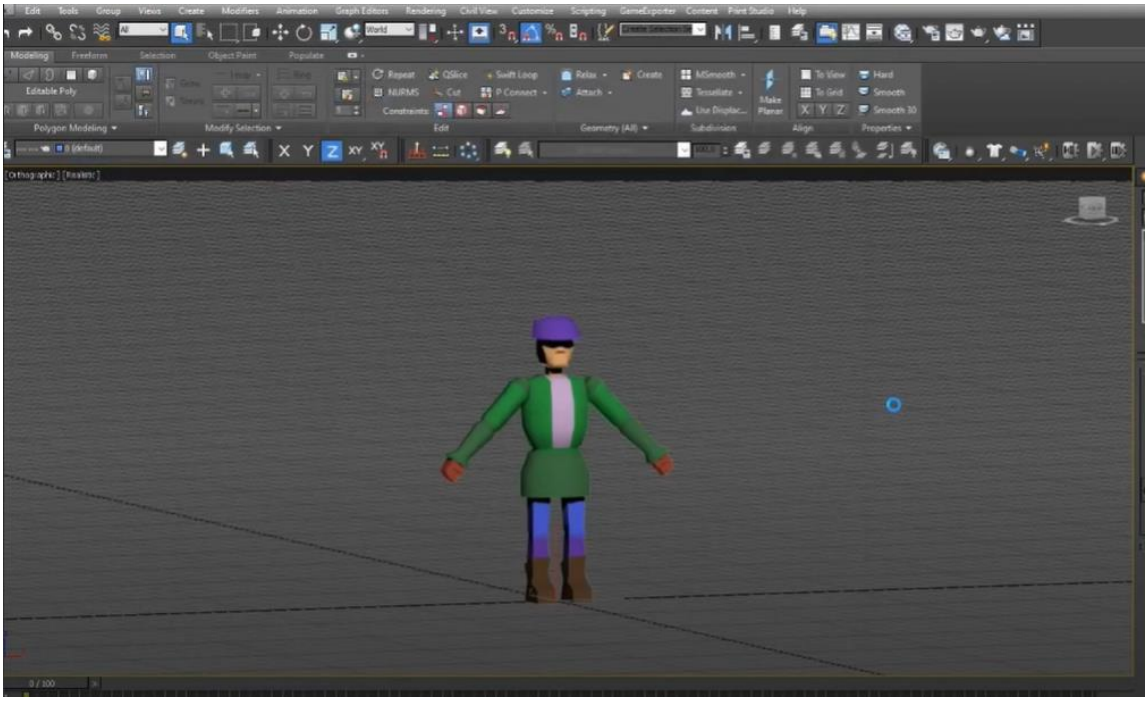


Figure 6. 3D character creation using the 3Ds Max Educational software.

- Installation of the Unity 3D Engine 2018.4.23f1 with Android support. A specific version of the engine was chosen that was tested throughout every scenario so as to avoid incompatibilities or other issues. Being a more lightweight Game engine, this could also help to maximize compatibility with a wide range of older hardware, allowing for more flexibility for the participants. The video[12] covers the installation process from start to finish, as well as the more elaborate Android integration that is required for the creation of the final file format for mobile devices. Android was also selected as it is used in a great variety of devices and the toolsets for development and deployment can be obtained free of charge and by all.
- Installation of the Unreal Engine 5.0[13] with Android support. A similar approach was followed for the choice of another very popular Game engine, along with the relevant Android development environment. This engine is usually more demanding hardware-wise but due to its popularity, features, and community, it proves to be a great alternative.

- Regarding the VR application creation, the following material was created:
  - Creation of a Virtual Reality Application for Android devices using the Unity 3D Game engine (**Figure 7**). In this two-part tutorial[14], a scene is created in Unity 3D and optimized for Virtual Reality on Android devices. Despite this being a feature no longer in development for Android devices, it still provides a solution widely available to a broad audience without the need to purchase expensive VR equipment. Scene setup with optimized graphics for mobile devices, 2D and 3D element placement and camera motion to facilitate the process of a VR narration through the elements of an artifact such as Rigas' Charta. The build process and application installation on an Android device with a demonstration are also presented.

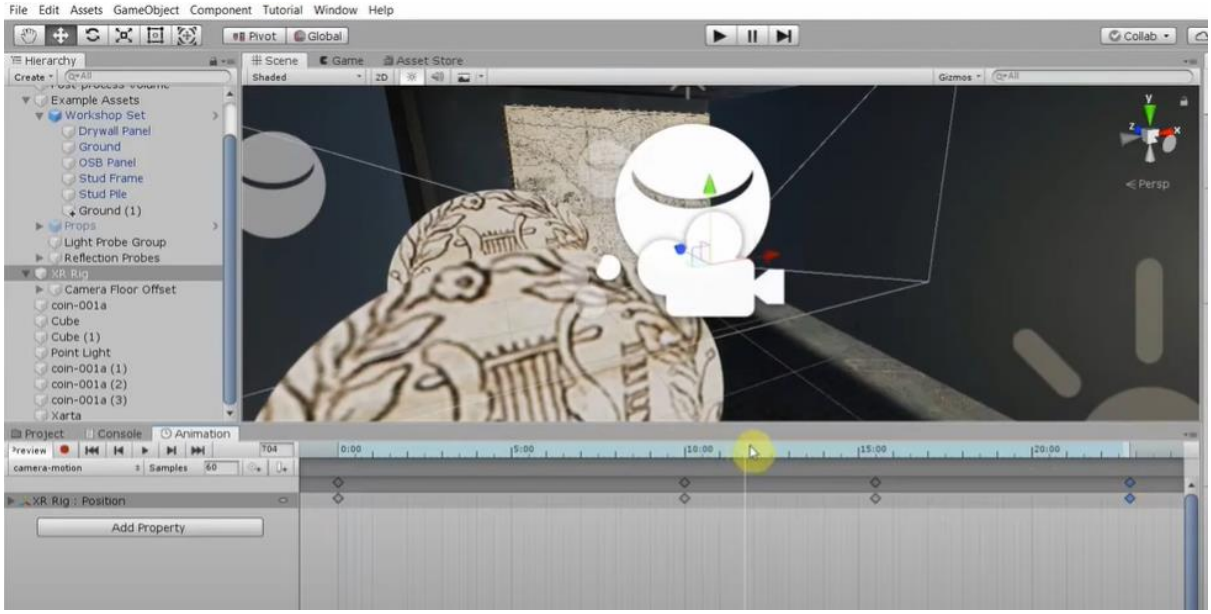


Figure 7. Virtual Reality Application creation in Unity 3D for Android devices.

- Creation of a Virtual Reality Application[15] with the Unreal Engine 5 (**Figure 8**). Utilizing the Unreal Engine, it is displayed how through the VR template preset we can easily build our own environment, import a previously created 3D character with animation and how to use custom 3D models for VR haptic controller interaction.

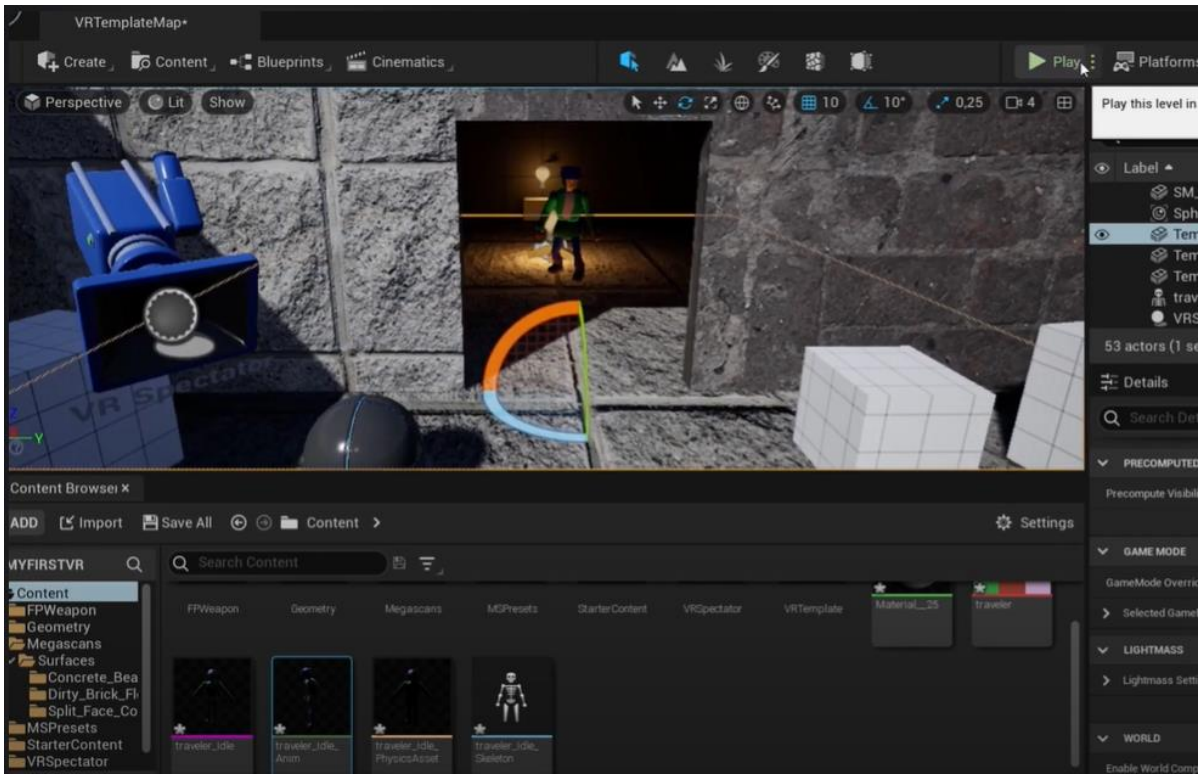


Figure 8. Virtual Reality Application creation in the Unreal 5.0 Game engine.

- Regarding the AR application creation, the following material was created:

- Creation of an Augmented Reality Application for Android devices using the Unity 3D engine and Vuforia (**Figure 9**): In this two-part video[16], the implementation of the AR Vuforia engine for Unity 3D is demonstrated in a step-by-step guide. The importance of clear markers for the quality of the real-time camera tracking is explained in the example of Rigas' Charta to achieve an optimal result. 2D and 3D objects are integrated into the 3D scene, and a short, loopable animation is created within the Unity 3D Game engine. Lastly, the creation process of the Android APK file is presented, and the installation process on an Android device with a live test reacting to the trigger image of Rigas' Charta.

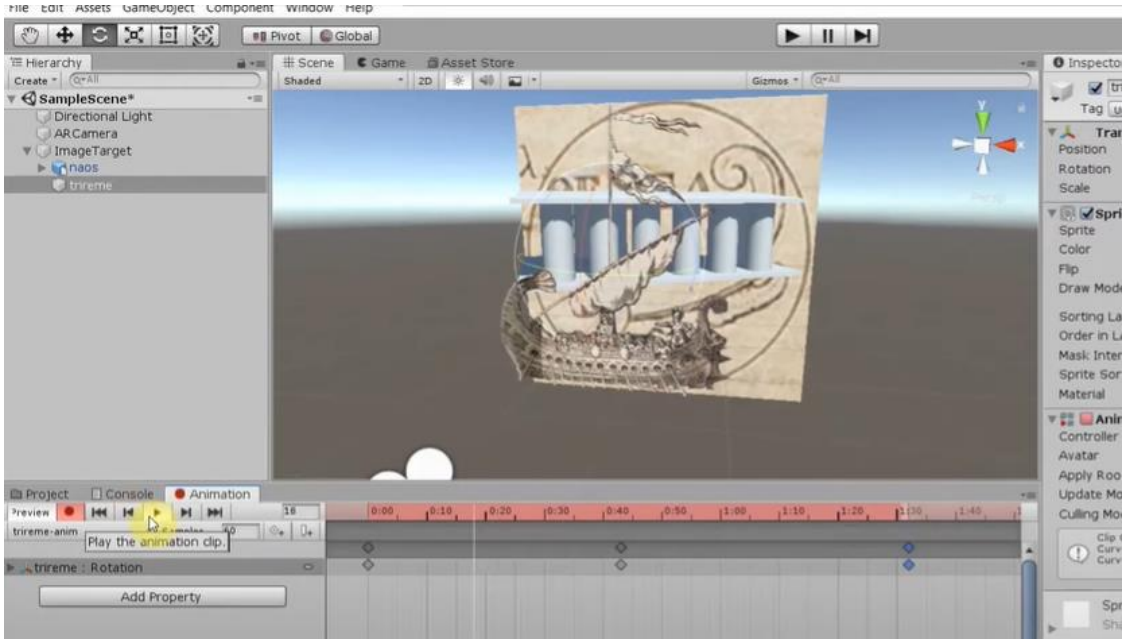


Figure 9. Augmented Reality Application creation in the Unity 3D Game engine.

- Unreal 5 AR application creation for tracking real-world objects[17]: In this occasion, Unreal Engine 5 is used with custom Blueprints code in order to track real objects using a camera to detect and highlight geometry in real-time through Augmented Reality using the Google AR Core framework.
- Using Unreal Engine 5.0 and AR Core to create an Android AR application[18]: Using Unreal Engine 5 and AR Core in order to embed 3D elements, importing and setting up the 3D character figure created on a previous workshop.

- Regarding the VideoGame creation, the following material was created:
  - Creating a First-Person Game with Unity 3D[19] (**Figure 10**). The creation process of a First-Person Game in the Unity 3D Game engine, explaining the concept of game design and level creation. Demonstration of the terrain-building toolsets and techniques, adding previously created 3D elements and particle effects, in-game geometry, and demonstrating how to set up, build, and run the final PC executable.

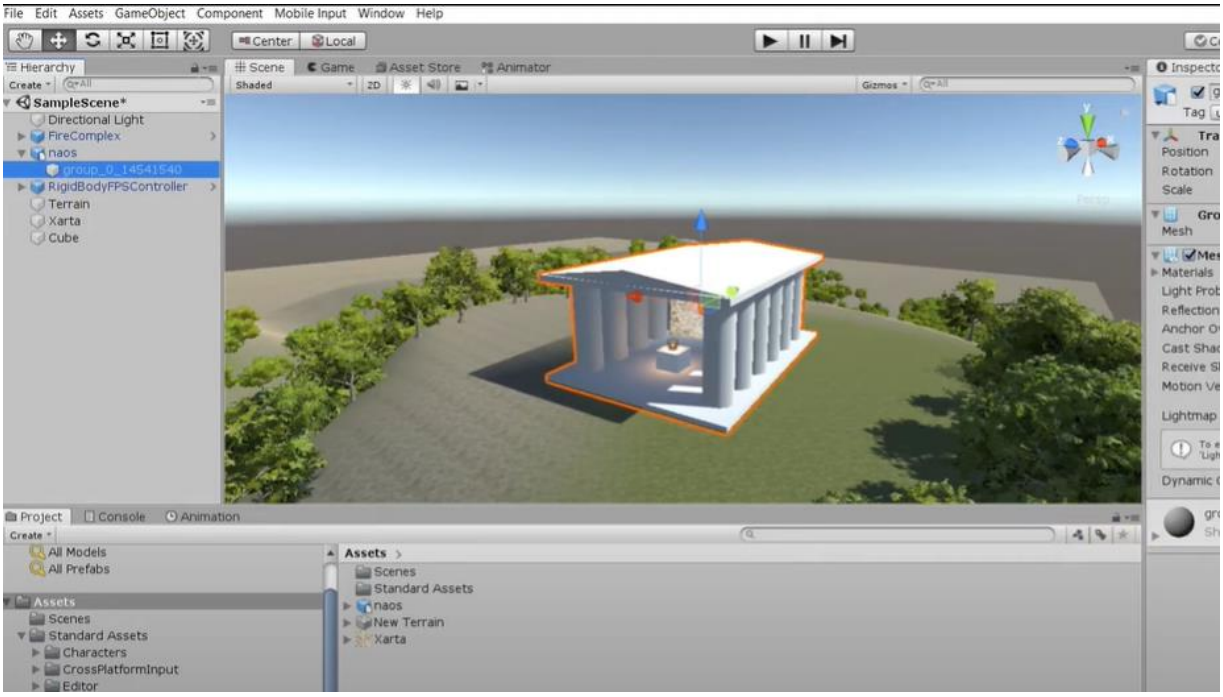


Figure 10. Creating a First-Person Game with the Unity 3D Game engine.

- Creating a First-Person Game using the Unreal Engine 5 (**Figure 11**). In this series of videos[20], it is demonstrated how to create a First-Person Game using the Unreal Engine 5 Game engine and how to use real-world terrain height data within the game engine as a virtual terrain, applying and combining different materials and textures, importing and setting up 3D scanned objects in order to enrich the scenery, and how to confine the game area through the use of collision boxes.

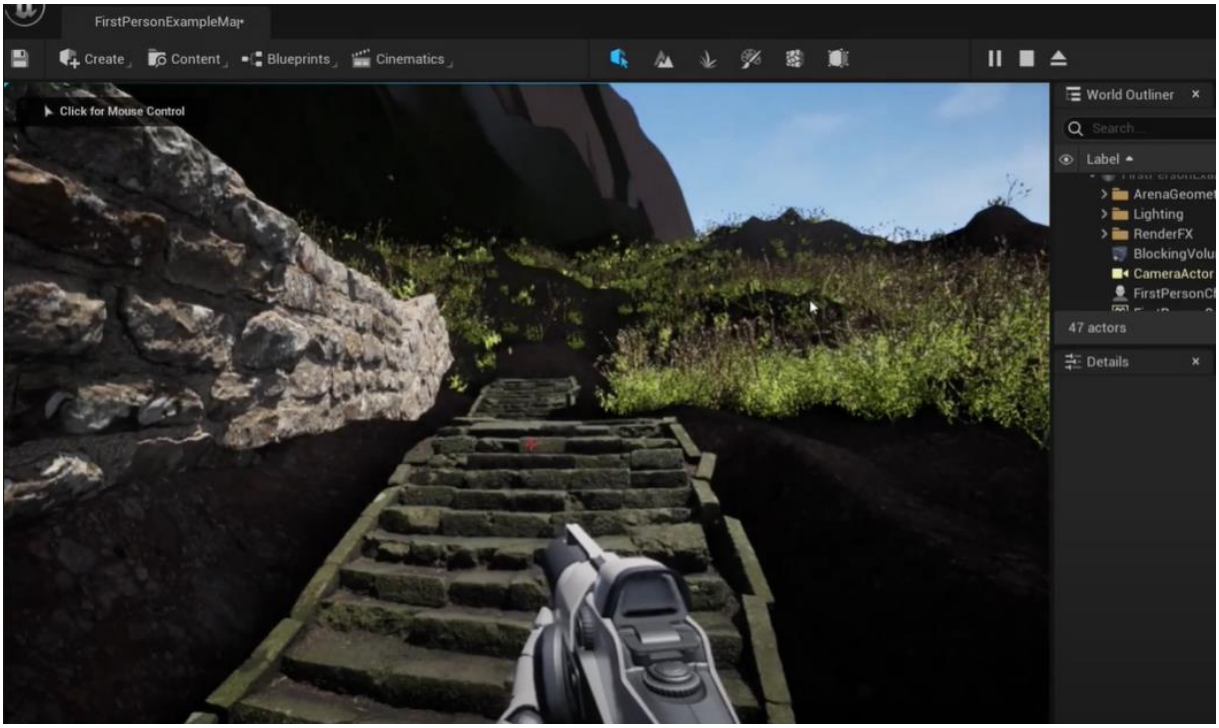


Figure 11. Creating a First-Person Game with the Unreal 5.0 Game engine.

- Regarding the Digital Narrative creation, the following material was created:
  - Openshot for Digital Storytelling[21]. The layout of the software is explained as well as basic concepts of video editing such as layers and layer order, blending, transitions, resolution, bitrate, framerate, and a composition is created using the free source material provided by the Onassis Classroom platform and several online repositories.

All of the above educational material was prepared until December 2020 and was uploaded on the educational platform "Classroom" to support the efforts of school teams and to inspire them to get involved in the educational competition.

4.7. Online workshops

To enhance the participants' digital skills and acquaint them with diverse digital applications and techniques, a series of online workshops, webinars, and presentations were organized. Expert researchers and scientists conducted these sessions via the Zoom and WebEx platforms, delving into specialized software, applications, and techniques. The session topics were tailored to align with the digital categories of the competition works, including VR, AR, Digital Storytelling, and 3D VideoGame specialized workshops.

The preparatory workshop series concluded with a problem-solving Q&A session, and all related materials were made accessible to the Classroom platform for all interested parties. This advanced digital experience provided students and their professors with an opportunity to enhance their understanding of 2D and 3D graphic design, VideoGame and application creation, animation, level and gameplay design, basic programming concepts, video creation, editing, and digital material processing. Additionally, they explored a variety of metaverse development tools, enabling them to breathe new life into a historical cartographic document and imbue it with new interpretations and meanings for future readers. The workshops were free and open to all. Specifically, some of the related workshops included:

- Rigas' Charta in the digital world—Hack the Map—11.02.2021[22] "The Battle of Dervenakia" (**Figure 12**). Using the 3Ds Max modelling software and the Unity 3D game engine, a scene was composed in order to recreate the historical scene of the Greek battle of Dervenakia[23]. The creation of a 3D flag was used as an example to demonstrate how to animate an object for a Game engine with bone usage, skinning and keyframe animation within 3Ds Max, whereas GIMP was used in order to create textures with transparency. All the material was then gathered inside of the Unity 3D game engine in a 3D layered composition by adding 2D and 3D elements, creating and detailing the terrain, adding particle and sound effects along with a camera motion so as to create a simple narration of the composition, presenting an animated version of the classic battle to the viewer.

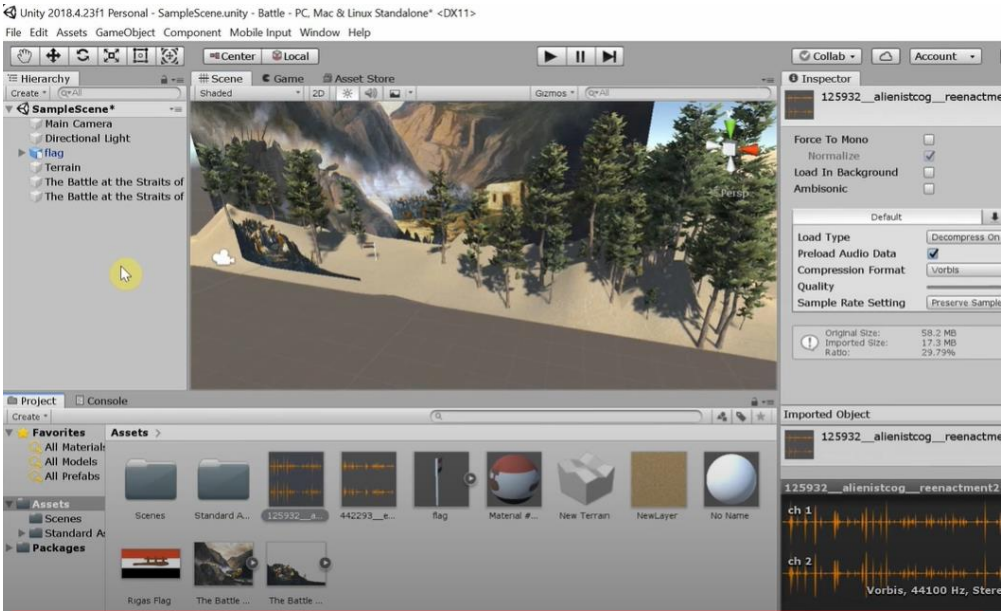


Figure 12. Rigas' Charta in the digital world—Hack the Map workshop.

- Building 3D models for imaginary worlds—Hack the Map—17.03.2021[24] (**Figure 13**). The notions of polygonal geometry creation, geometry flow and optimization for games were presented, how 3D axes, pivots and units are used and their best practices, how by using the 3Ds Max software the creation of basic objects can be easily achieved, and how this geometry can be enhanced by editing it to add details. It was demonstrated how to duplicate geometry and make clones, techniques used to add variation for the duplicate objects from a single object like a tree or a rock. Additionally, modeling with splines was demonstrated as an alternative method to create a tree trunk and how this can be turned into geometry, and the process of creation for the models of a windmill, houses, a bridge, and vegetation using various modifiers available to the software was presented.

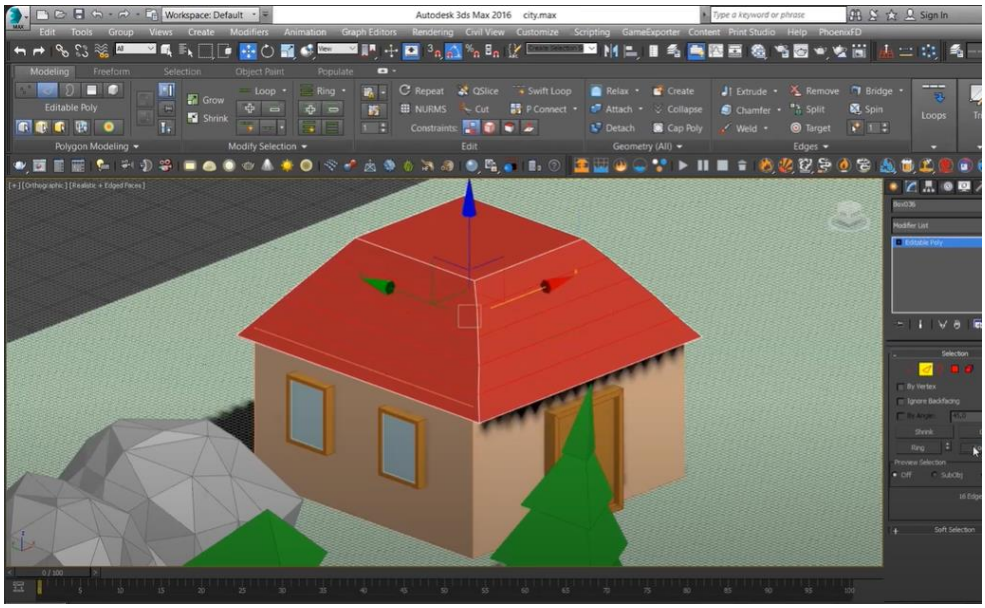


Figure 13. Building 3D models for imaginary worlds—Hack the Map workshop.

- Adding materials and textures to 3D Models—Hack the Map—31.03.2021[25] (**Figure 14**). This workshop explained the concept of texturing and unwrapping a 3D object, in which the surface of a 3D model is unfolded onto a single 2D square space of a certain pixel resolution (i.e., 1024 by 1024 pixels) in order to be painted on, with the final result being displayed back onto the 3D model. The difference between the various texture maps, such as diffuse or normal maps and the concept of optimization with regards to textures was covered. Using the online image editing software Photopea, the creation of tilable textures was covered to apply them back in a 3D object inside of the 3Ds Max software. Basic UV unwrapping techniques and how to create a variety of textures that can be reused on multiple objects to save system memory, such as wood for trees, a bridge, house elements, etc., and other best practices were also presented.

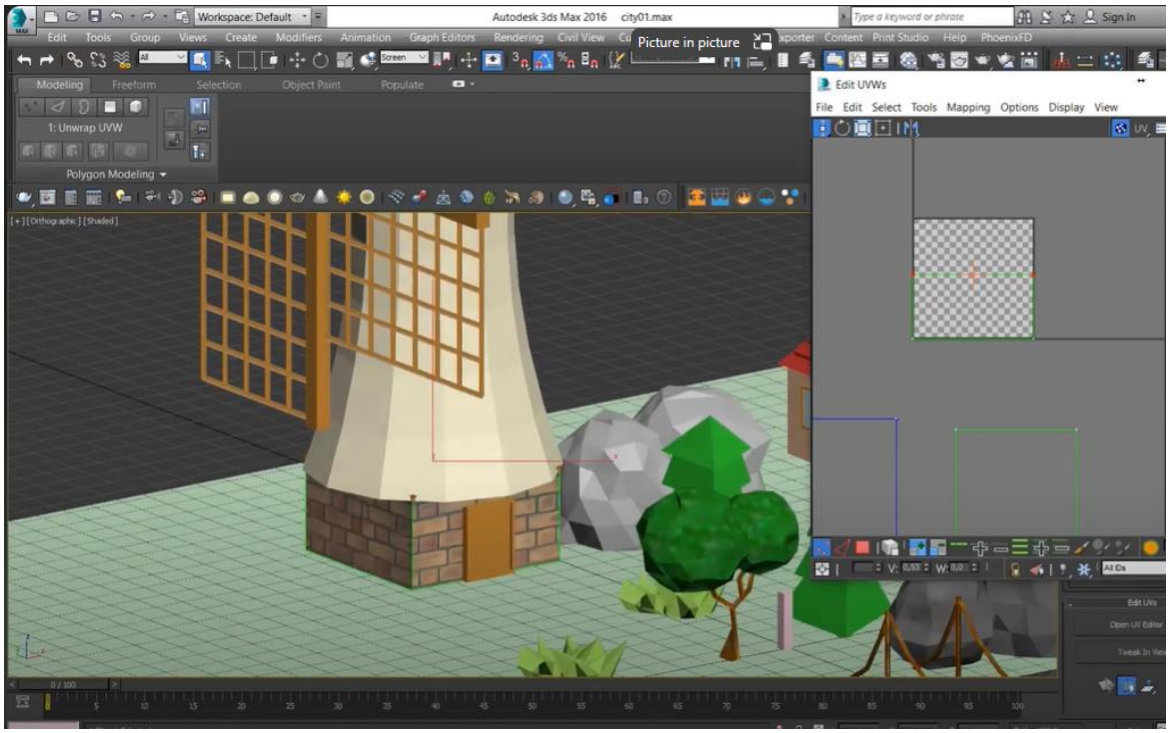


Figure 14. Adding materials and textures to 3D models—Hack the Map workshop.

- Creating animations for 3D models—Hack the Map—07.04.2021[26] (**Figure 15**). An introduction to animation and concepts like keyframes, loops and hierarchies was presented. Continuing with the material created in the previous workshops, an animation for the windmill was created inside the 3Ds Max software. The object linked in a parent-child hierarchy and a motion with the appropriate keyframe type that can loop forever seamlessly was created and explained. This is a fundamental concept as most of the animations created for VideoGame s are intended to play in a loop. The process of creating bones and skinning objects such as a tree and a bridge was demonstrated, as well as a more advanced setup using a biped skeleton for a biped character rig and animation.

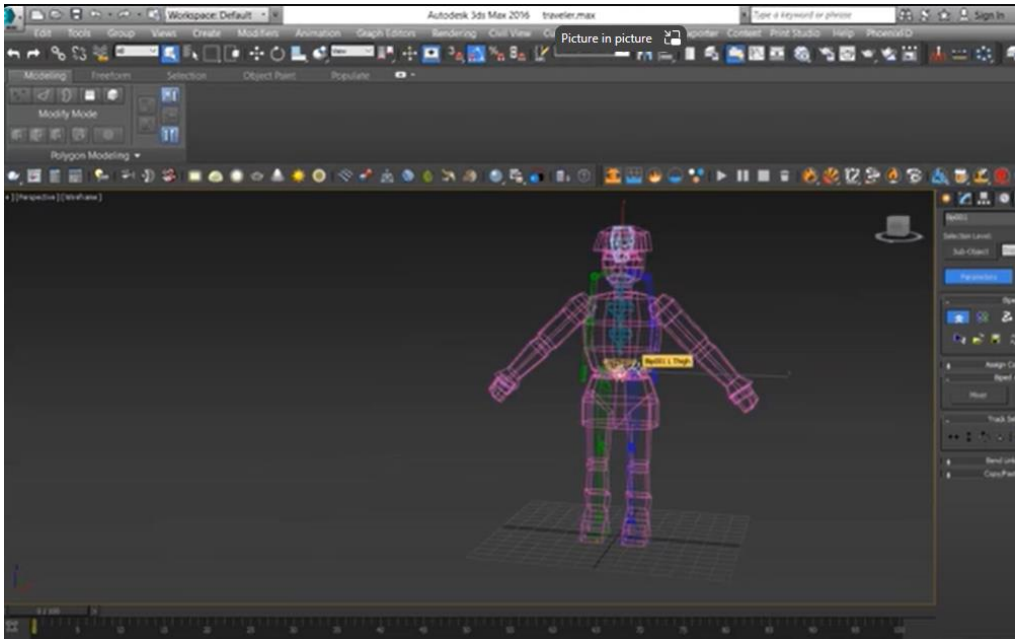


Figure 15. Creating animations for 3D models—Hack the Map workshop.

- Incorporating 2D and 3D elements into Game engines and Q&A—Hack the Map—14.04.2021[27] (**Figure 16**). Core game design concepts were explained, the work process of exporting models from the 3Ds Max software to the Unity 3D and the Unreal game engines, such as those of rock assets and the animated trees created on the previous workshops. The animated models of the windmill and the bridge were also imported, and a simple level was created with the models, materials, and animations set up inside of the game engine. The importance of color and lights as a mechanism was presented and emphasized for the game design creation, as for example the use of a light source in order to highlight a point of interest and draw the player's attention. Furthermore, the importance of collisions in a level was discussed for detection and definition of the game area.

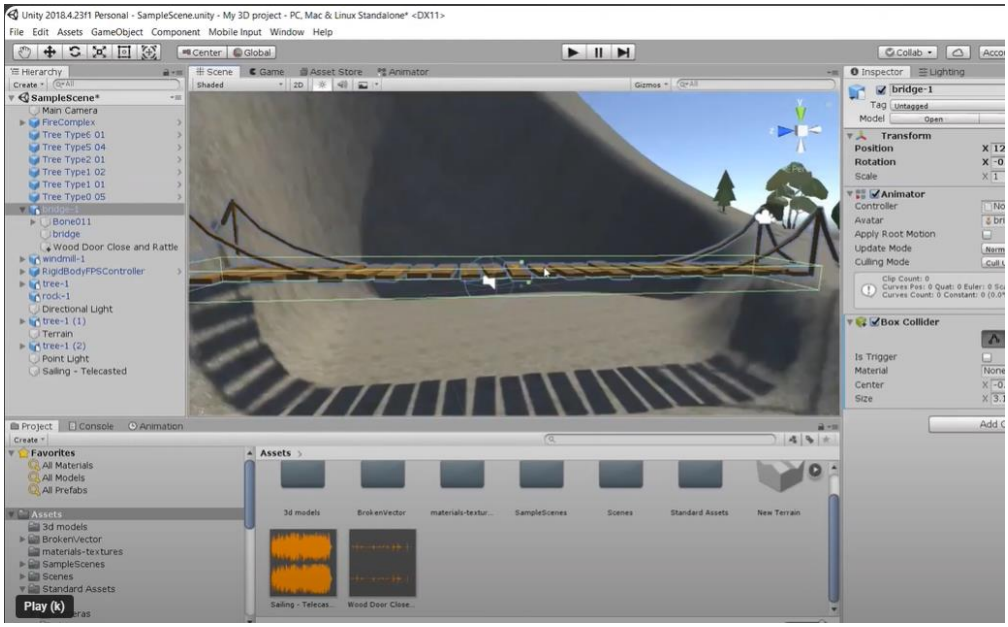


Figure 16. Incorporating 2D and 3D elements into Game engines and Q&A—Hack the Map workshop.

- Q&A and Intermediate 3D Graphics WorkShop—Hack the Map—12.04.2021[28] (**Figure 17**). Using the image editing software GIMP to cut a coin out of the Charta map was presented as the purpose of this advanced 3D workshop was to bring to life a drawing from Rigas' Charta. This was then imported into 3Ds Max and set up in order to create a 3D geometry model, that of a crab as depicted on one of the coins featured on the Charta. Projection mapping techniques for the easy texturing and UV mapping were demonstrated, and how to optimize the geometry and retopologize it for a better polygon flow, how to add custom bones in a full skeleton hierarchy and animate them, and finally how to import the result into the Unity 3D Game engine and set it up as a 3D element that pops out to life from Rigas' Charta.

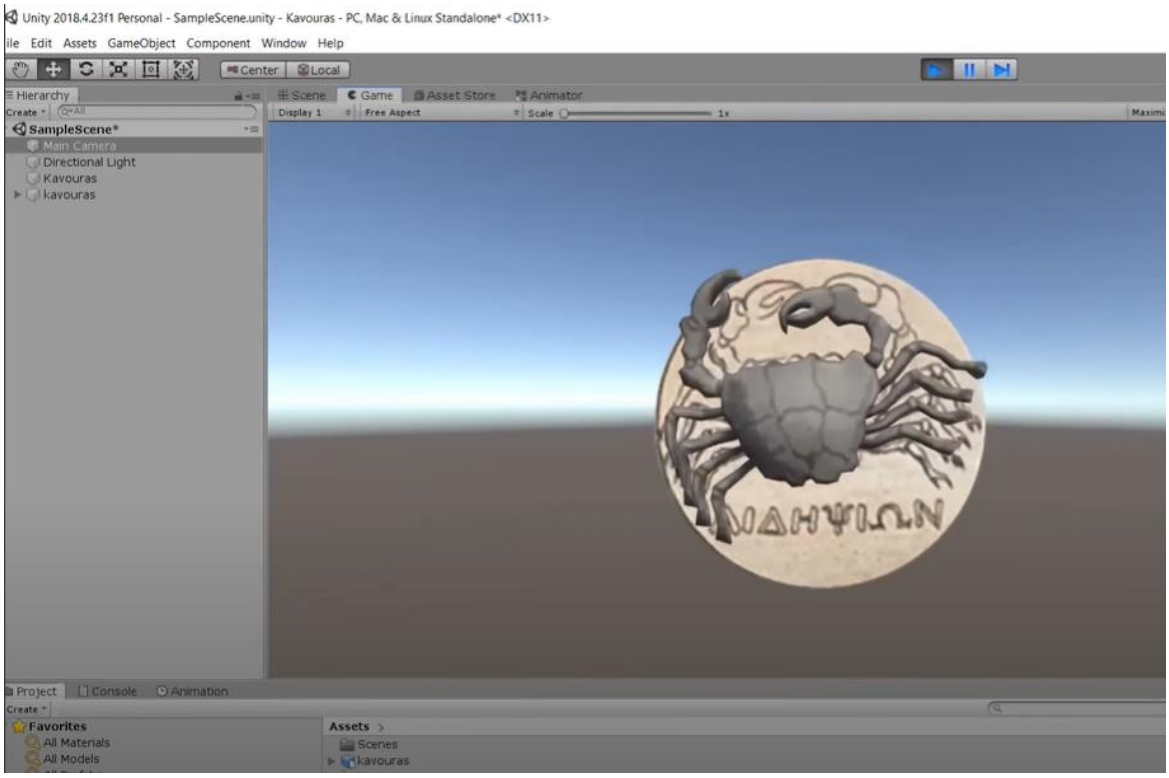


Figure 17. Q&A and Intermediate 3D graphics—Hack the Map workshop.

- AR WorkShop with Unity 3D—Hack the Map—30.03.2021[29] (**Figure 18**). In this workshop, it was demonstrated how to use the template scenes provided at the Onassis Classroom for AR content and the Vuforia AR engine. It was shown how to create an enhanced scene with loopable graphic elements such as sea waves, world creation and terrain techniques; how to use the image editing software Photopea in order to process textures and import them into Unity 3D; how to use free game assets and implement them into the project; how to create and customize particles; how to write custom code so as to trigger events; and how to create custom selection buttons, making a complex multimedia AR scene.

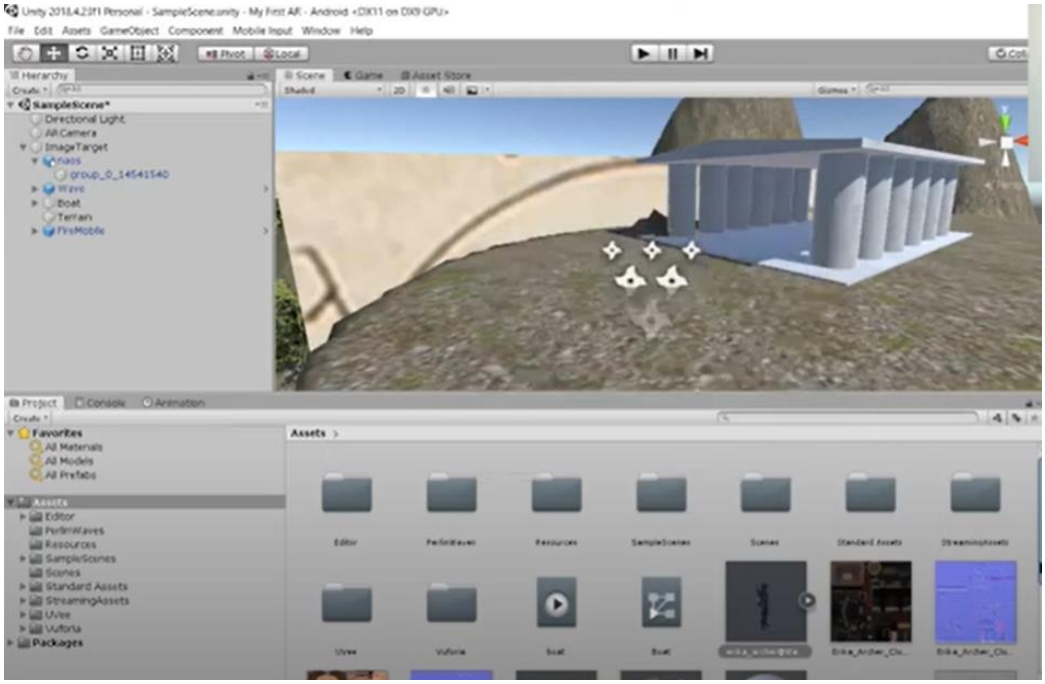


Figure 18. AR WorkShop with Unity 3D—Hack the Map.

- VR WorkShop with Unity 3D—Hack the Map—01.04.2021[30] (**Figure 19**). In this workshop, it was demonstrated how, by using the Unity 3D VR template freely available at the Onassis Classroom, a complete VR scene can be created. It was presented how to create simple scripts in C# in order to interact with the viewer, how to place information graphic pop-up boxes, and how to trigger them in order to enrich the VR navigation experience as the viewer would navigate across the elements of the Charta map. The flow of creation for additional levels was also presented, as well as the necessary steps and techniques for level transitions.

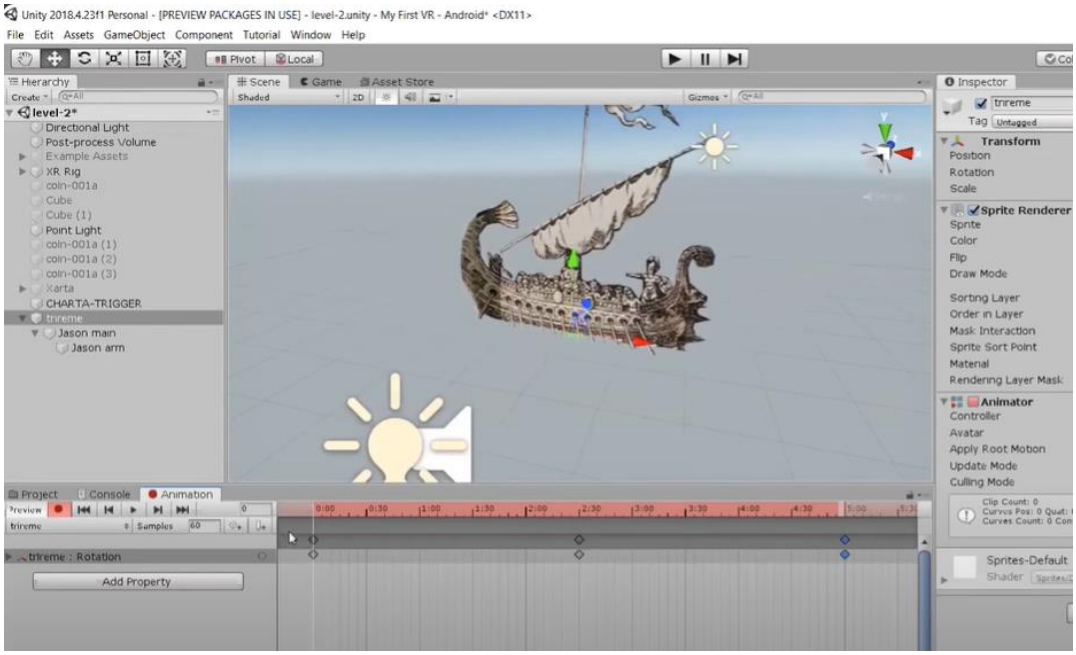


Figure 19. VR WorkShop with Unity 3D—Hack the Map.

- 3D Video Game WorkShop with Unity 3D—Hack the Map—08.04.2021[31] (**Figure 20**). Using the free material available at the Onassis Classroom for the VideoGame template, core level design concepts were demonstrated with the creation of the 3D scenery enriched by a forest, the drawing of a pathway towards the point of interest, a temple from the Charta of Rigas. The usage of particles and lighting was analyzed, how to import, convert and animate a variety of 2D and 3D elements within the level, how to add collisions for the player and the objects created, how to create game mechanisms such as a riddle-solving mechanism with a button in order to answer correctly a question and open the temple door using simple scripting in C#. Multiple level creation and transitioning were showcased, with the creation of an additional level within the temple where animated platform mechanics were created.

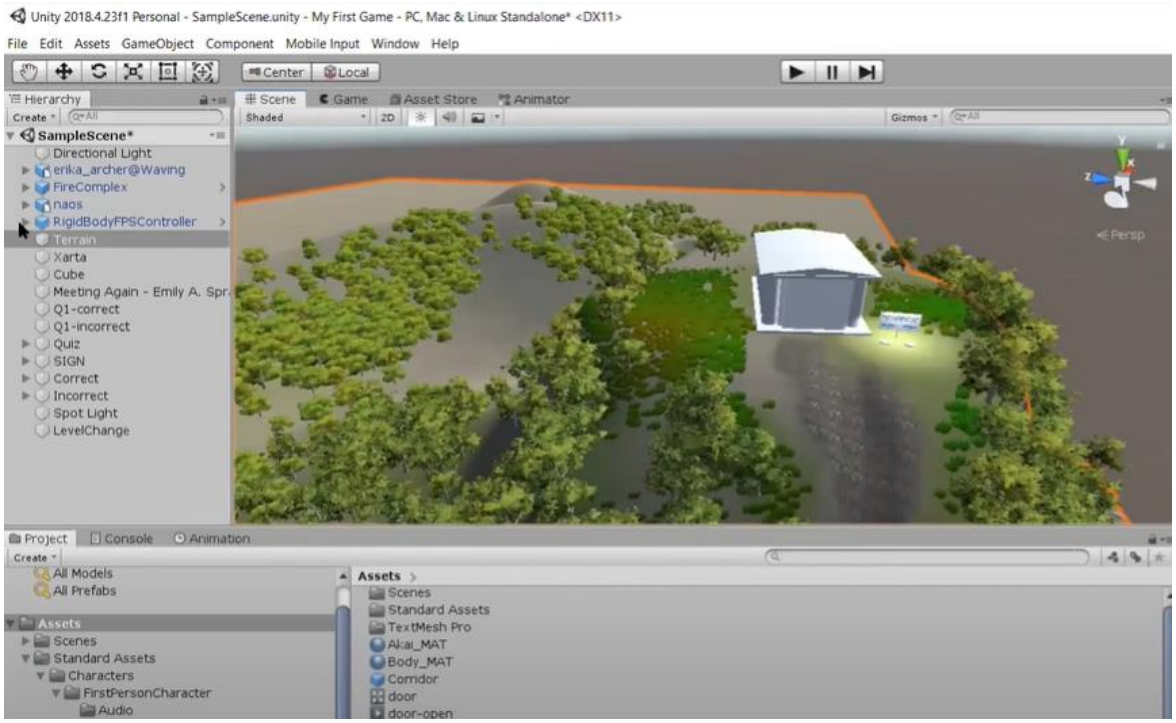


Figure 20. 3D Video Game WorkShop with Unity 3D—Hack the Map.

- Digital Storytelling WorkShop with Openshot—Hack the Map—06.04.2021[32] (**Figure 21**). Using the free material provided in the Onassis Classroom, basic synthesis was explained and the layer structure of a free video editing software like OpenShot. Storytelling concepts were presented, how to import and animate a diverse range of material formats, or how to create original material using the image editing software PhotoPea. Effects, blending, transparency, transitions, and animation techniques were presented; the usage of sound effects and the rendering process was also explained, as well as the concepts of resolution, bitrate, and video formats.

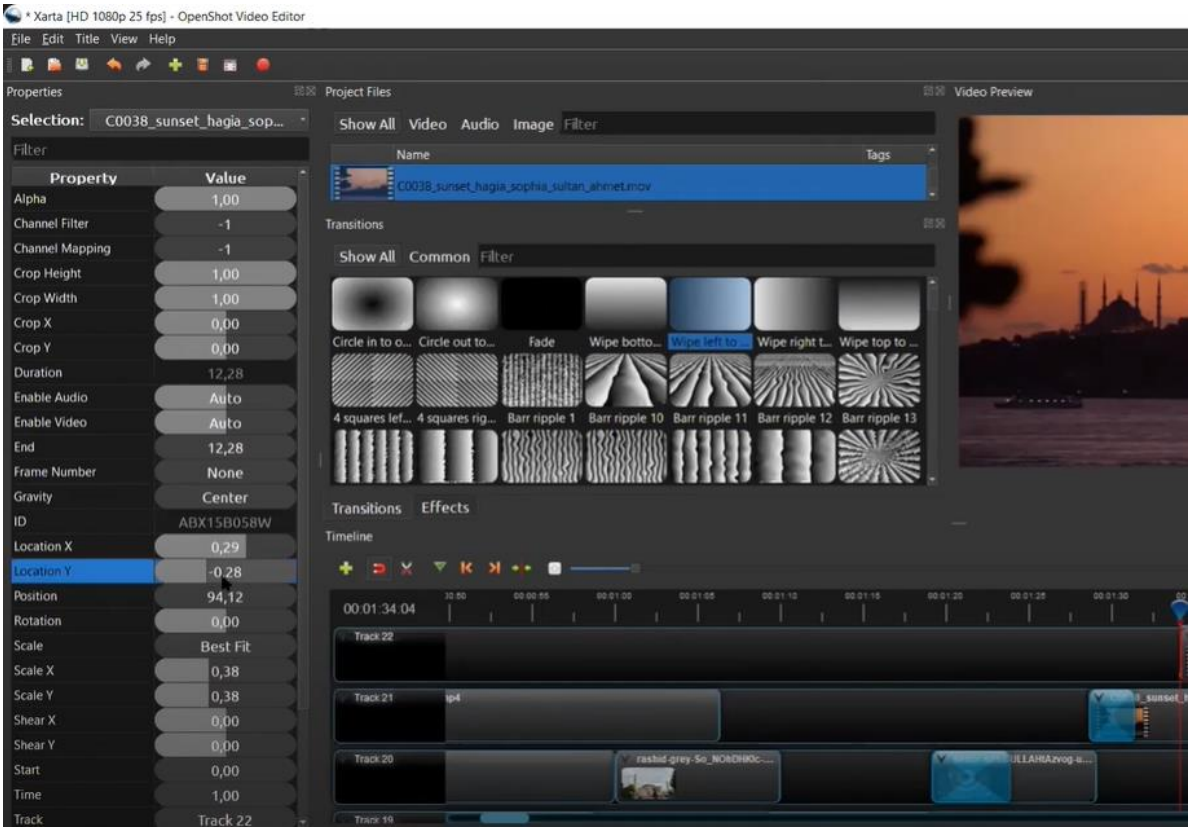
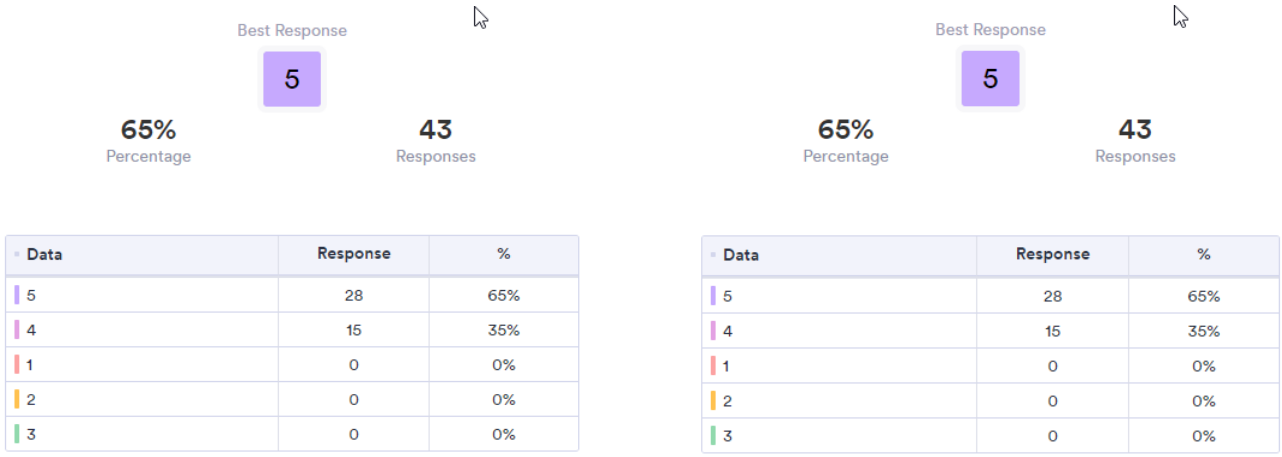


Figure 21. Digital Storytelling WorkShop with Openshot—Hack the Map.

5. Evaluation

All educational programs and materials underwent evaluation through written anonymous questionnaires[33], garnering positive comments from participants, including students, parents, educators, and external scientific collaborators as they managed to unify the fields of information technology, history, geography, cartography, visual arts, and museum education. The programs were widely regarded as original, innovative, and interdisciplinary, with a noteworthy emphasis on their synthetic approach. The success and innovation of their execution were attributed to the high level of the instructors and scientific collaborators and to the support provided by a structured, functional, and user-friendly educational digital platform (Classroom). This platform significantly facilitated remote communication and interaction between organizers and participants, becoming an ongoing online repository of high-quality educational material.

The qualitative and quantitative analysis of 100 questionnaires submitted by educators and students can be found below (**Figures 22–29**).

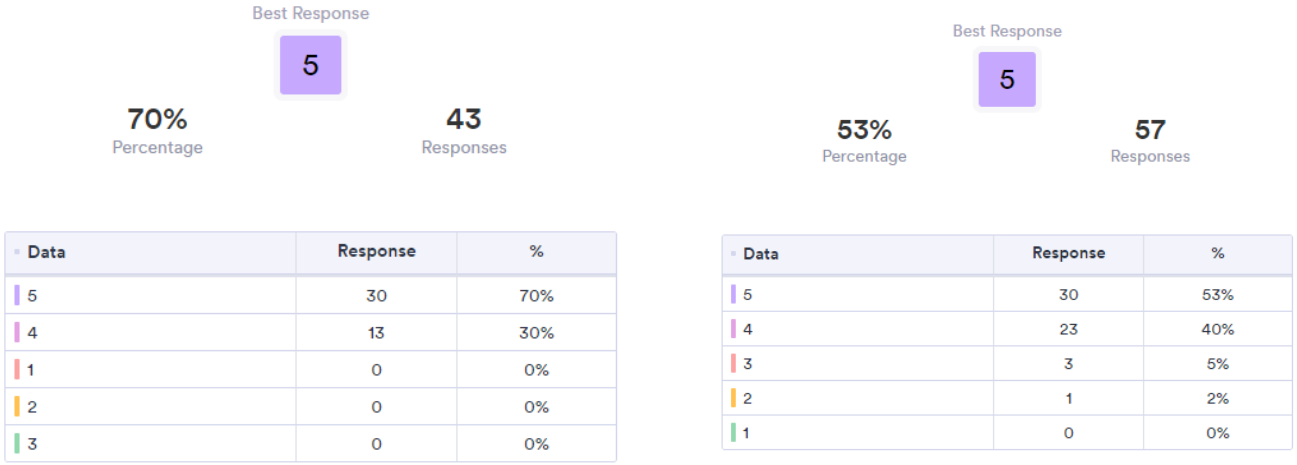


Data	Response	%
5	28	65%
4	15	35%
1	0	0%
2	0	0%
3	0	0%

Data	Response	%
5	28	65%
4	15	35%
1	0	0%
2	0	0%
3	0	0%

(a) **(b)**

Figure 22. The digital educational platform was user-friendly, **(a)** educators; **(b)** students.

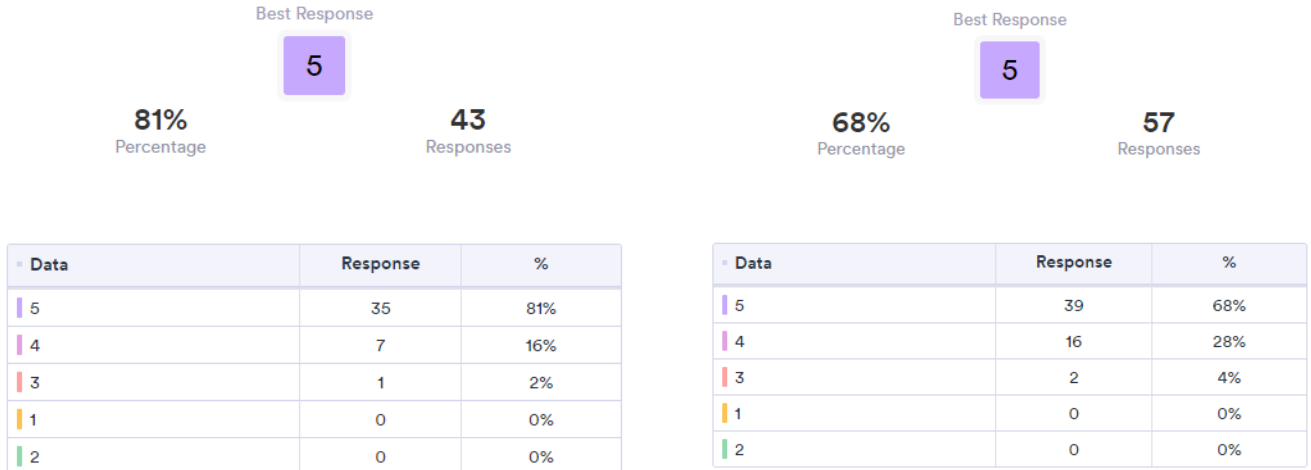


Data	Response	%
5	30	70%
4	13	30%
1	0	0%
2	0	0%
3	0	0%

Data	Response	%
5	30	53%
4	23	40%
3	3	5%
2	1	2%
1	0	0%

(a) **(b)**

Figure 23. The educational program was well structured, **(a)** educators; **(b)** students.

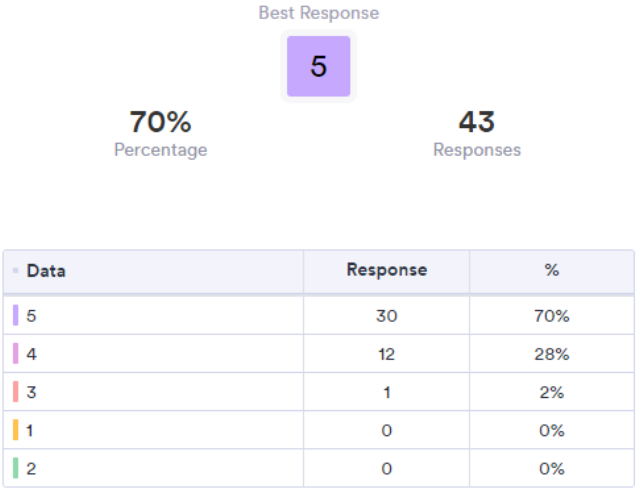


Data	Response	%
5	35	81%
4	7	16%
3	1	2%
1	0	0%
2	0	0%

Data	Response	%
5	39	68%
4	16	28%
3	2	4%
1	0	0%
2	0	0%

(a) **(b)**

Figure 24. The content of the educational program was innovative, **(a)** educators; **(b)** students.



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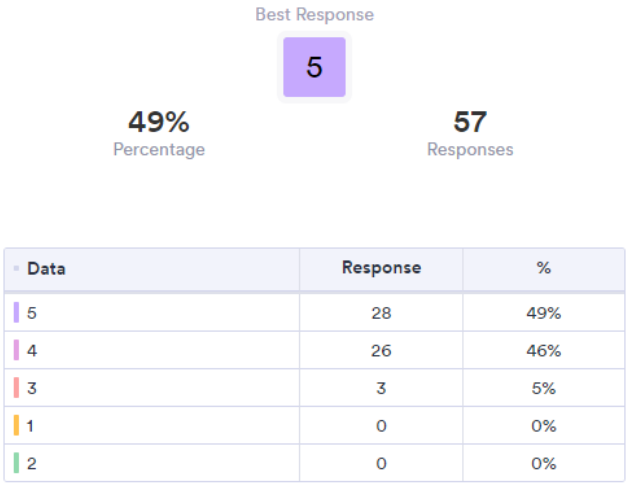
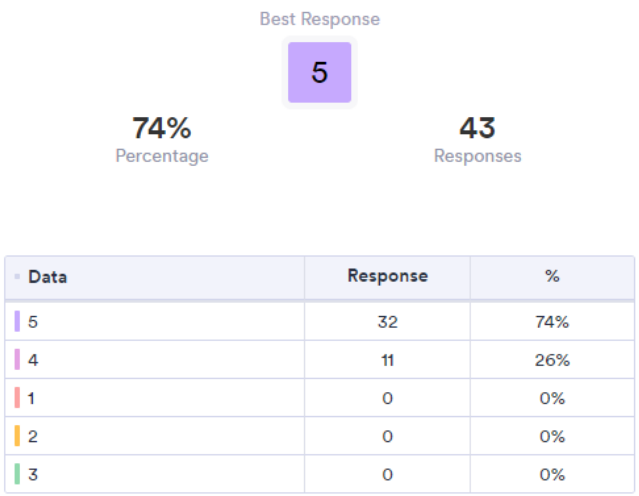
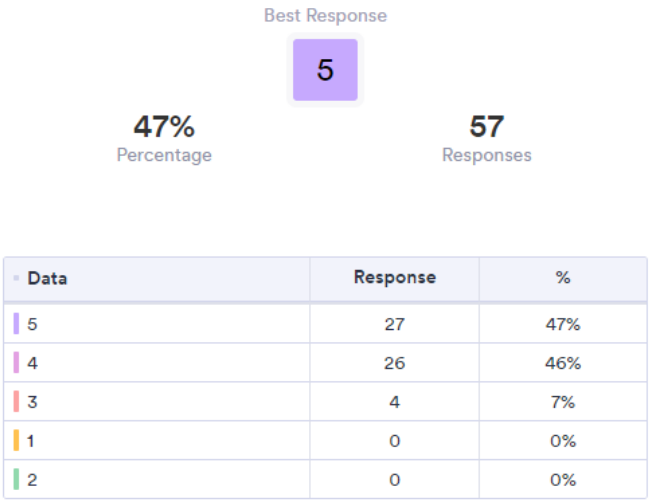


(b)

Figure 25. The educational program generated new ideas, **(a)** educators; **(b)** students.

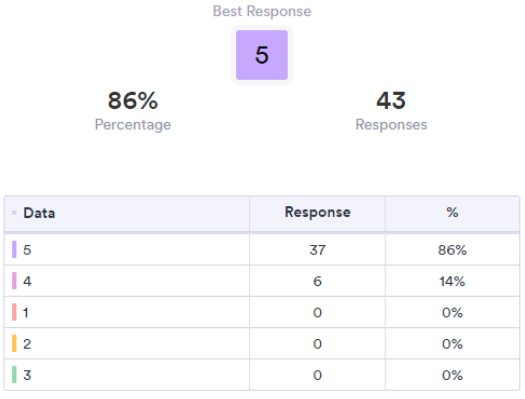


(a)

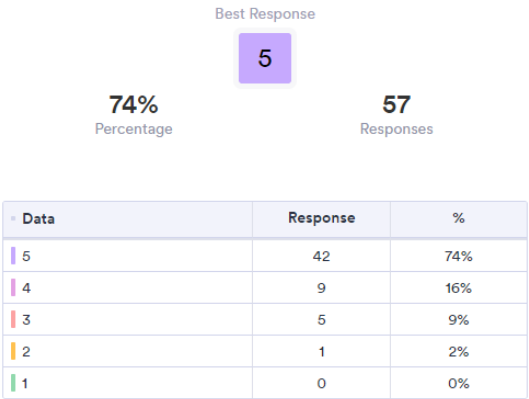


(b)

Figure 26. The educational program gave me useful information, **(a)** educators; **(b)** students.

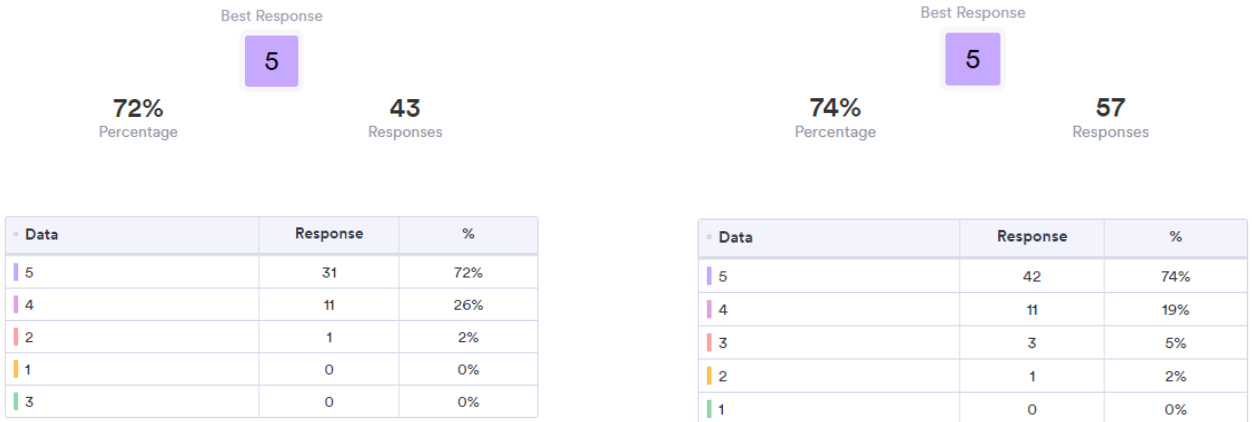


(a)



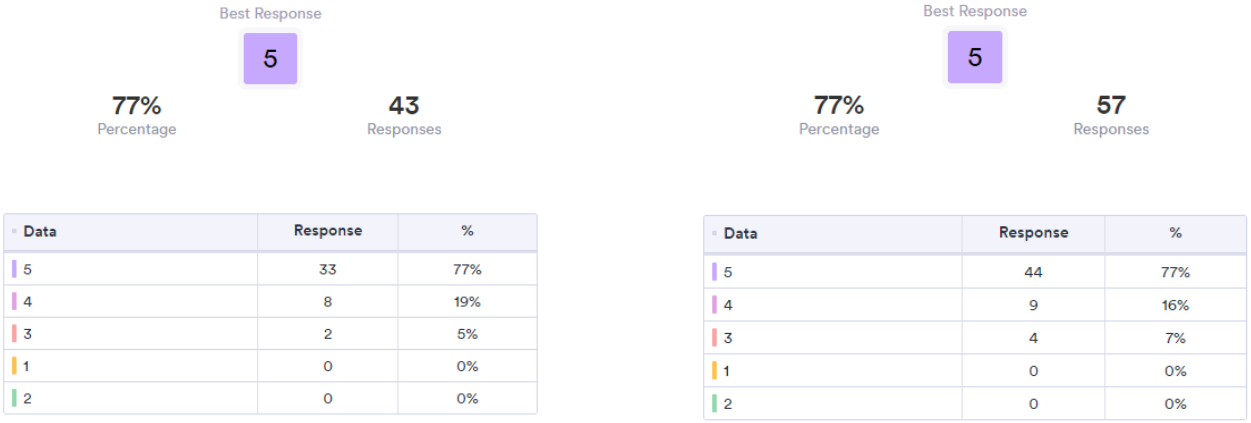
(b)

Figure 27. The instructors were adequately prepared for the subject matter they presented, **(a)** educators; **(b)** students.



(a) **(b)**

Figure 28. The instructors were engaging, **(a)** educators; **(b)** students.



(a) **(b)**

Figure 29. The instructors were open to the dialogue, **(a)** educators; **(b)** students.

In response to open-ended questions, educators expressed their preference for various aspects of the program. They particularly appreciated the webinars, well-organized materials, the integration of technology, the historical theme of educational programs, the diverse range of materials, interdisciplinary elements, support from organizers, innovation, the implementation phase, achieved results, and the infusion of creativity. Conversely, students highlighted their enjoyment of collaborating with educators, working across different specialties and talents, being exposed to new technologies, connecting historical subjects with modern technological tools, engaging in meaningful dialogue, and experiencing a learning process that felt like a game.

However, both educators and students acknowledged common challenges, including the constraint of limited time for implementing digital projects, the high level of competition difficulty, the use of advanced technological tools, the impact of the challenging COVID-19 pandemic situation, the weight of great expectations, and the technical constraints they faced in managing and transferring large volumes of files to meet deliverable deadlines.

The presenters were evaluated as excellently prepared for the topics they presented, effective in knowledge transfer, and open to dialogue, fostering a collaborative and participatory atmosphere. The presentations were deemed useful, substantive, informative, and the provided educational material was well-organized, explanatory, and with a clear structure. This enhanced creativity and increased involvement in the research process, changing the views of the participants about complex and difficult lessons.

Moreover, the utilization of new technologies in the context of the competition enabled interaction, free navigation, adoption of roles using avatars, multisensory interaction channels, and non-linear presentation of information. In this way, it contributed significantly to enhancing participation, exploratory learning, imagination, and memory. Furthermore, the creative engagement with the old document of Charta led to a deeper understanding of its significance and its connection with the other publishing works of Rigas Velestinlis. Regarding the influence of the series of educational programs dedicated to historical documents, it's noteworthy that numerous school teams showcased their digital projects at both national and international conferences[35]. This exposure enabled them to reach a broader audience and take significant strides in their future development.

In addition, for at least one program (student competition), a feedback session[36] was conducted to assess the results and the impact it had on the students. From the school presentations and team members' talks, it became evident that this specific initiative served as a soothing, meeting point, and unforgettable experience for students who had no prior knowledge of the competition's topic or digital applications. It facilitated the exchange of ideas, collaborations with individuals of different specialties, diverse learning styles, and various talents. The participants were enthusiastic, felt gratitude, and considered it a revealing experience. They generated knowledge, became creators and presenters, gained autonomy, strengthened their self-confidence, transformed difficulties into opportunities, discovered and highlighted other aspects of their personalities. Combining different scientific fields, their participation broadened their horizons, offered equal participation, and provided knowledge through experiential learning. The initiative brought out new teaching methods, different approaches to teaching challenging subjects, bringing together different disciplines and arts.

Furthermore, despite their specialization around a single historical object, all educational programs effectively engaged the majority of participants, underscoring Charta's importance and extensive research possibilities. The digital school projects affirmed initial concerns and ideas, as students demonstrated genuine connection and inspiration drawn from this monumental document of cultural and cartographic heritage, thereby enhancing their creativity. Moreover, the fusion of new technologies with the knowledge domains of Modern Greek History, Geography, Cartography and Visual Arts was deemed highly beneficial for the learning process, enhancing participants' digital skills, and fostering a deeper appreciation of Greek cultural heritage among the new generation.

Both students and educators expressed a desire to repeat similar initiatives in the future and advocated for their inclusion in the school program, with several institutions

participating again in later competitions. They also articulated ideas and proposals for new training sessions in digital tools, applications, and platforms.

6. Conclusion

Living in the digital age today, we have a great opportunity to bridge the gap across diverse scientific fields. Leveraging powerful technological tools allows us to minimize distances, connect with previously unknown audiences, and foster communicative, social, and cultural links, thereby transforming how we relate, learn, and interact [21]. Archives and libraries are dynamically evolving in their relationship with new technologies, significantly altering how we receive and process information while unlocking possibilities for reviving the past.

Addressing the challenges of a rapidly changing world, the Onassis Library has successfully maintained and strengthened its bonds with audiences through innovative online and on-site educational activities. These initiatives have reached Greek students nationwide and abroad, fostering a meaningful dialogue with the Hellenic cultural heritage and promoting collaboration between cultural and educational organizations. By preserving and reinterpreting historical material and primary sources using new digital approaches for future generations, challenging conventional practices, inventing new communication routes, thinking innovatively, and extending social and educational benefits, we have realized the potential to broaden and enrich our understanding of history.

Hack the Map Competition and Classroom educational platform of the Onassis Foundation were created to enhance the cultivation of varied digital skills of the participants and bring them in contact with innovative digital tools VR, AR, 3D Video Games, and Digital Storytelling, stepping up access to distance learning. It managed to combine the digital world with the humanities and make our cultural heritage accessible to the general public. The main challenge is the task of preserving and reinterpreting historical material and primary sources in new digital ways for future generations, hacking standard practices, thinking out of the box, and extending their social and educational benefits. Moreover, the participants in the project were encouraged to get familiarized with the archival cartographic material, explore it, and use it together with modern digital technologies, in order to develop higher-order learning skills of interpretation and evaluation, to reveal the amount of information given by maps and to understand how the use of old cartographic, symbolic, literary and archival material for educational purposes could broaden and enrich the way we perceive history.

The series of educational programs inspired by Rigas' Charta served as a prime example of how historical documents can be integrated into the educational process and give new meaning in the dialogue with future learners. This approach engages young people, encourages cross-disciplinary interpretations by incorporating various scientific fields, and applies methodologies such as Object-Based Learning (OBL), Game-Based Learning (GBL), and Project-Based Learning (PBL) together with metaverse applications and techniques. Through this inclusive interdisciplinary approach, Rigas' Charta is presented in a comprehensible and modern manner, inspiring and motivating the new generation to interact with cartographic heritage,

extending the life of old material through the use of advanced digital applications and metaverse development tools. This innovative learning approach, which sets the groundwork for a new educational model tailored to contemporary learners, successfully blends the digital world with the humanities. It leads to a deeper understanding of our cultural wealth, making it accessible to the educational community and the public. Consequently, it would be highly valuable to continue offering a meta-life to various other old materials[37–39], providing a supplementary and effective method of teaching difficult and demanding subjects, by designing similar activities to be incorporated in the future school curricula and be embraced by other cultural and educational organizations.

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Notes

1 https://play.google.com/store/apps/details?id=com.kosmad.rigasmap

2 https://www.onassis.org/whats-on/paintelling-travelling-with-the-symbols-and-myths-of-rigas-charta/digital-material-a-journey-with-the-myths-and-symbols-of-rigas-charta-through-a-childrens-book

3 http://dhawards.org/dhawards2021/results/

4 For more information see the presentation in the 8th Panhellenic Conference on 21st century Education and Culture, 13–14 May, 2023: https://ekedisyconference.weebly.com/uploads/1/3/4/7/13471246/%CE%93%CE%B5%CF%81%CE%BF%CE%BD%CF%84%CE%BF%CF%80%CE%BF%CF%8D%CE%BB%CE%BF%CF%85.pdf

5 Watch the digital school projects on Rigas' Charta: https://classroom.onassis.org/course/view.php?id=43

6 https://classroom.onassis.org/course/index.php?categoryid=3

7 https://vod-progressive.akamaized.net/exp=1704480521~acl=%2Fvimeo-transcode-storage-prod-us-east1-h264-1080p%2F01%2F480%2F26%2F652404448%2F3017832372.mp4~hmac=9a4f30448958d6edb5f3a48e13c60dcdf271ebe7236aa8657c415bffee91fab9/vimeo-transcode-storage-prod-us-east1-h264-1080p/01/480/26/652404448/3017832372.mp4?filename=1080p.mp4

8 https://www.youtube.com/watch?v=bIrKjjwSU0o

9 https://www.youtube.com/watch?v=1aWAVPIXHIU

10 https://www.youtube.com/watch?v=1Io7UCSAfhU

11 https://www.youtube.com/watch?v=QLEEkXSFUWU

12 https://www.youtube.com/watch?v=97-uAYMmxpo

13 https://www.youtube.com/watch?v=5tQOLxfJ7sw

14 https://www.youtube.com/watch?v=sRTGnwzmCeI

15 https://www.youtube.com/watch?v=YWfJAonHmkw

16 https://www.youtube.com/watch?v=3xNhABWqJQc

17 https://www.youtube.com/watch?v=VR4tXDnsWd8

18 https://www.youtube.com/watch?v=xc1GNCFsZ3o

[19] https://www.youtube.com/watch?v=heX9_ctt2ho
[20] https://www.youtube.com/watch?v=WmyuX3BIH20
[21] https://www.youtube.com/watch?v=8vgSWv5JdJk
[22] https://www.youtube.com/watch?v=Y6KasNrcrdU
[23] https://www.nationalgallery.gr/en/artwork/the-battle-at-the-straits-of-dervenakia/
[24] https://www.youtube.com/watch?v=Y6KasNrcrdU
[25] https://www.youtube.com/watch?v=Y6KasNrcrdU
[26] https://www.youtube.com/watch?v=YhekzBFJk6E
[27] https://www.youtube.com/watch?v=oiVO_6-pER0
[28] https://www.youtube.com/watch?v=jEDzmvNwAkg
[29] https://www.youtube.com/watch?v=tzIvJs7rqG8
[30] https://www.youtube.com/watch?v=DzNkYO4_Aws
[31] https://www.youtube.com/watch?v=wI70G2cCH7g
[32] https://www.youtube.com/watch?v=J_UqIZm50KI
[33] You can see here the feedback questionnaire: https://eu.jotform.com/203411977981362
[34] Figures 22-29 were created using the digital tool https://eu.jotform.com/ and are based on responses from participants in the educational program assessment questionnaires.
[35] Mavroudaki, G. et al, History and Cartography meet youth through Digital Technology, (Vocational High School of Kamatero-Attica) Vol. 17 No. 1 (2023): Proceedings of the 17th European Conference on Games Based Learning, https://papers.academic-conferences.org/index.php/ecgbl/article/view/1713 and Korasidi, A., Merkouri, A., Rigas' Charta: Design and Development of a Complex Digital Game on the Unity 3D Platform by High School Students, Presentation at the 17th European Conference on Games Based Learning by the school team of Doukas School (Private Gymnasium-Lyceum-Athens) that awarded the first prize at the Hack the Map: Rigas' Charta digital competition in the 3D Video Game category.
[36] See here the award ceremony and the online presentations of the winning school projects: https://classroom.onassis.org/mod/page/view.php?id=1364
[37] https://www.onassis.org/whats-on/hack-the-map-imaginary-worlds
[38] https://www.onassis.org/whats-on/hack-the-art-yanoulis-halepas
[39] https://www.onassis.org/initiatives/onassis-library/digital-material-ioannite-printers-marks-in-venice-from-the-17th-to-19th-centuries

References

1. Tolias G. A Farewell to Genus: Patriotism and Empire in Rhigas' Cartographic Work, 1796–1797 (Greek). Menandros for the General State Archives. 2010.
2. Karamberopoulos D. Rhigas Velestinlis (1757–1798) and his revolutionary plan for a democratic state at the balkan area. Academia. 2008.
3. Karamberopoulos D. Rhigas Velestinlis, Map of Greece…, Vienna 1796–1797. Scientific Association of Studies Pheres-Velestino-Rhigas. 1998.
4. Karamberopoulos D. Rhigas Velestinlis, Revolutionary Scripts. (Revolutionary Proclamation-Human Rights-The Constitution-Thourios). Scientific Society of Studies Pheres-Velestino-Rhigas. 2003.
5. Laios G. The Maps of Rigas. Research on new sources (Greek). Bulletin of the Historical and Ethnological Society of Greece. 1960; 14: 231–312.
6. Livieratos E. On the cartography of Rigas Charta. e-Perimetron. 2008; 3(3): 120–145.
7. Hatzigianni K. Educational Activities from the General State Archives of Greece: Examples of Implementation. In: Vakalopoulou M, Karapidakis NE (editors). Archives. The Practices of General State Archives of Greece; 2012.
8. Sarra. Historical Research Group of the PSPA Archive 1929–1989. Available online: http://www.pspa.eu/index.php/drastiriotites-pspa/mathitikoi-omiloi/69-mathitikoi-omiloi-2017-18/136-omilos-istorikis-erevnas-arxeiou-pspa (accessed 20 December 2023).
9. Chatterjee HJ, Hannan L, Duhs R, et al. In: Object-Based Learning: A Powerful Pedagogy for Higher Education. Routledge; 2013.
10. Chatterjee HJ, Hannan L. Engaging the Senses: Object-Based Learning in Higher Education. Routledge; 2015.

11. Hardie K. Wow: The power of objects in object-based learning and teaching (Innovative pedagogies series). Available online: https://s3.eu-west-2.amazonaws.com/assets.creode.advancehe-document-manager/documents/hea/private/kirsten_hardie_final_1568037367.pdf (accessed 20 December 2023).
12. Romanek D, Lynch B. Touch and the Value of Object Handling: Final Conclusions for a New Sensory Museology. In: Chatterjee HJ (editor). In Touch in Museums: Policy and Practice in Object Handling. Berg; 2008.
13. Papadakis S, Kalogiannakis M. Evaluating the effectiveness of a game-based learning approach in modifying students' behavioural outcomes and competence, in an introductory programming course. A case study in Greece. International Journal of Teaching and Case Studies. 2019; 10(3): 235–250.
14. Deterding S, Dixon D, Khaled R, et al. From game design elements to gamefulness: Defining "gamification". In: Proceedings of the 15th International Academic Mindtrek Conference: Envisioning Future Media Environments; 28–30 September 2011; New York, NY, USA. pp. 9–15.
15. Diamantis K, Gerontopoulou V, Pazarli M. Bringing to life Rigas Velestinlis' Charta of Greece (1796–7) by using Augmented Reality Technology and 3D visualization. History, Computer Science, Art. 2022. doi: 10.5281/zenodo.5881728
16. Gerontopoulou V. Live online tours of the Onassis Library. In: Proceedings of the 8th Panhellenic Conference "Education & Culture in the 21st century"; 13–14 May 2023.
17. Sideris N, Gerontopoulou V. Unlocking Cultural Heritage: How the Onassis Library Embraces Technology to Connect with Society. In: Proceedings of the 53rd LIBER Annual Conference; 3–5 July 2024; Limassol, Cyprus.
18. Pazarli M, Diamantis K, Gerontopoulou V. Hack the map', a digital educational program inspired by Rigas Velestinlis' Charta of Greece (1796–1797). International Journal of Cartography. 2021; 8(3): 1–16, doi: 10.1080/23729333.2021.1972908
19. Diamantis K, Gerontopoulou V, Pazarli M. The Panhellenic Student Competition "Hack the Map: Rigas' Charta"—Building a new educational paradigm for generation next. In: Proceedings of the 2nd International Online Conference on Digital Transformation in Culture and Education; 16–17 May 2022; Belgrade, Serbia.
20. Sofos A. Digital Literacy as a Category of Media competence and Literacy—an Analytical Approach of Concepts and Presuppositions for Supporting Media Competence at School. In: Bauer P, Hoffmann H, Mayrberger K (editors). Fokus Medienpädagogik—Aktuelle Forschung-und Handlungsfelder. Kopaed; 2010. pp. 62–82.
21. Figuerdo OB, Sarmiento JA. The challenge of training university professionals to integrate mobile learning. Educacion Medica Superior. 2017; 31(1): 61–77.