A Web Gamification Platform Inspired by the Maritime Tradition Museum in Perama, Greece, for Students in the Sector of Maritime Professions in Vocational Education and Training

Dimitrios Kotsifakos, Maria-Gerasimoula Karali, Eirini Katzola, Achillia Kravvari, and Christos Douligeris

Abstract — Technical education mainly focuses on practical training and skills-based learning and pays less attention to the theoretical background of its graduates. The officially instituted curriculum of Greek Vocational High Schools includes a wide range of Specialties among which is the Sector of Maritime Professions. In our proposal, we aim to introduce a new approach to Vocational Education and Training, specifically in the Maritime Professions Sector, by implementing gamification combined with museum education practices and new technologies to create a game about ancient seamanship. The game is an educational structure that includes a virtual space, created in Artsteps, a platform for creating virtual reality exhibitions, and a quiz that by presenting hypothetical scenarios will make students compare the use and function of ancient and modern marine tools thus learning more about maritime history while enjoying themselves. The main goal of our proposal is the development of a strong overall learning experience through gaming that will also broaden students’ knowledge of the history of their future profession and deepen their understanding of its significance and evolution throughout the years. This game was played and evaluated positively during the 2021–2022 school year by 120 Vocational High School students.

Keywords — Digital Culture, Gamification, Museum Education, Vocational Education, and Training.

I. INTRODUCTION

Vocational High Schools in Greece provide a wide variety of Sectors and Specialties to their students. Among those, is the Maritime Professions Sector which starts in the 2nd Grade of High School and offers two Specialties in the 3rd Grade, Merchant Marine Captain, and Engineer. Students in this Sector are trained in several subjects related to their chosen field but none of them is maritime history. In general, history is not part of the Vocational High Schools’ curriculum, neither in each sector’s lessons nor in those of the general education. Our paper proposes an innovative approach to introducing historical elements into the technical curriculum of Vocational and Educational Training (VET) by presenting an educational tool that combines gamification with museum education practices for VET students. It focuses on students who wish to follow maritime professions and have chosen the respective Sector in the Greek Vocational High School. Through this gamified environment, the students will be introduced to the history of seamanship, not by applying traditional methods of teaching that tend to be more theoretical and less appealing to students who do not have a strong background in history, since the last time these students were taught history would have been in the Lower Secondary School (Gymnasium).

The application of gamification in the past decade has seen a significant increase and has produced positive results. Thus, many fields use it as a teaching method, especially combined with new technologies. Gamification is already incorporated in education as well as in VET, in various ways, by taking advantage of the way it transforms classrooms into interactive environments that offer students more interesting and entertaining learning experiences. Moreover, gamification allows students to improve and develop their skills, creativity, and critical thinking [2]. Combining gamification digitally with museum education practices, based on constructivism and the museo-pedagogical method of discovery that focus on actively creating knowledge by interacting with the museum and its exhibits [3], and using the Maritime Tradition Museum in Perama, Greece, and several of its artifacts about ancient seamanship and marine technology as an inspiration, we aim at introducing Vocational High School students who follow the Maritime Professions Sector to some basic information about the history of the field. This introduction will be accomplished through a game, which consists of a virtual space created in the Artsteps platform2, where several tools of ancient marine technology will be displayed for students to explore, and a quiz with hypothetical scenarios where they will have to compare ancient and new technology. By finding the correct answers the students will better understand the historic continuity of these inventions by drawing parallels between the old and the new [4]. Since, as mentioned before, the student’s involvement with history, maritime or otherwise, is minimal, we propose that the game is implemented after visiting the Museum and after having interacted with it and its exhibits in person, to have acquired

2https://www.artsteps.com/
some knowledge about ancient seamanship through the activities offered there.

The paper is organized as follows. We start by presenting the impact and benefits of gamification in VET and the previous works on the subject as well as by analyzing the curriculum in the Maritime Professions Sector. Then, we proceed to explain the reasoning behind choosing the Maritime Tradition Museum in Perama as an inspiration for such a game. After that, we analyze the design and the concept of the game followed by the results of its evaluation during the 2021–2022 school year. Finally, we present our conclusions and plans for future work.

II. GAMIFICATION IN VOCATIONAL EDUCATION

The concept of gamification emerged just before 2010 [5] and has since been applied in many sectors of our lives including education. Gamification is the application of game-design elements to non-game contexts, thus allowing learners to improve their knowledge of a subject through games; thus, a serious process, such as teaching, is transformed by adding entertaining elements [1], [6]. Extensive research on gamification has shown that it has serious benefits for students of all educational sectors, including VET, where the main focus is primarily on practical training and skills-based learning [2] and teaching methods aim at mastery over competency since the graduates are expected to assist, as future professionals and parts of each country’s workforce, in achieving sustainable economic growth and socio-economic stability [1]. Hence, there is a need to enrich VET with innovative and engaging practices such as gamification to increase the student’s understanding of the subjects they cover in their education and their motivation within a dynamic environment that does not just focus on the practical side of things but also improves personal skills, creativity, persistence, responsibility, and ultimately produces empowered graduates.

Furthermore, the inconsistency in terms of behavior in VET students is a challenge faced by teachers who only employ traditional methods. Many students find these traditional methods repetitive and disengaging. Memorizing as a means of learning does not provide understanding or help students retain knowledge. Thus, the application of gamification helps teachers resolve some of those issues and creates a more inviting, student-centered environment. Students tend to become more active and avoid boredom and discontentment while they overcome many motivational and engagement barriers. In addition, the use of technology and multimedia improves their digital skills, their development process skills, and problem-solving abilities and stimulates their creativity and imagination. Even though these two targets are not the main focus of technical education, in reality, creativity is behind every cultural activity and enables artistic, scientific, and technical creation [7]. Thus, its encouragement should concern VET teachers as well. That is why there is also a need for teachers to combine pedagogical and technological elements while implementing digital tools in their teaching, to contribute to well-rounded learner development[8].

According to Theodule Ribot, “every invention before actually being implemented in reality, existed and was held together by imagination”, thus cultivating that aspect of the student's personalities through gamification is not insignificant just because they chose to enroll in technical education, but it would help them broaden their horizons and gain entertaining experiences that would also result in accumulating knowledge. With all that being said for the gamification’s benefits in VET, we should always keep in mind that it is no panacea and should be applied by the teacher with careful planning and preparation, taking into account both the learning subjects and the student’s needs.

III. THE CURRICULUM OF THE MARITIME PROFESSIONS SECTOR IN VOCATIONAL HIGH SCHOOLS

According to the recent reforms of the Vocational High Schools and Vocational Education and Training, students who are oriented toward the Maritime Specialties have the right to choose directions from the Maritime Professions Sector3. According to the Greek Government Gazette B/26-5-2016, as of the 2017–2018 school year, the 3rd Grade of the Maritime Professions Sector of the daily and evening Vocational High Schools consists of the following specialties: “Merchant Marine Captain” and “Merchant Marine Engineer”. In the 2nd Grade of the daily VET school, the students attend twenty-three (23) hours of maritime sector courses and 12 hours of general education courses per week, while in the evening VET schools, the students attend twenty (20) hours of sector courses and ten (10) hours of general education courses per week. Then, in the third grade of the daily VET school, after choosing one of the two aforementioned specialties provided by the Sector, they attend twenty-three (23) hours of sector courses in each specialty [9].

The graduates of the “Merchant Marine Captain” specialty can be the captain of the ship and at the same time the owner's representative on board. They chart the course of the ship, direct and organize the work of the entire crew as well as being responsible for the safety of the ship, crew, cargo, and passengers. They need to cooperate with both the engineer and the shipping company.

The graduates of the “Merchant Marine Engineer” specialty can be responsible for the maintenance and proper functioning of the ship's engines, along with the calculation and work mainly in the engine room where they control the maintenance and the proper function of the engines, and the supplies of fuel, water, lubricants, and spare parts of the ship. They in turn need to cooperate with the captain and the shipping company.

By studying the profiles of the graduates regarding the needs for their professional integration, we recognize the importance of the curriculum options regarding the professional orientation of the maritime specialties. Apart from that, seamanship is – traditionally – a key pillar of the Greek economy with a significant contribution to the Greek Gross National Product [10]. Its success is largely based on its human resources, both in terms of management personnel


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(Captains-Engineers) and in terms of training of all the other maritime skills that a ship needs. Maritime professions are areas that require responsibility, leadership, and engineering skills, as well as knowledge of foreign languages, especially English, good physical strength, and stamina, and also love and familiarity with the sea.

For each direction, the maritime studies in Vocational High Schools focus on general education but, the intended learning outcome focuses on the orientation of the modern shipping industry’s needs for the training of a ship’s crew. We should also highlight that the maritime industry is in constant evolution and that it is imperative to monitor intensively the technical, information and telecommunication changes on a global level. Additionally, to shield VET students scientifically and to better prepare them on a theoretical basis, we believe that the Greek maritime executives who graduate from the Greek Vocational Lyceums should also have a minimum of historical memory when it comes to their profession, at least as far as the field of the ancient Greek maritime technology is concerned. References to the transitional phases of the history of modern maritime technology would also be beneficial.

The students need to understand the role that Greek seamanship has played over the years and the evolutionary trajectory of maritime technology. By viewing and interacting with ancient marine tools, it is easier for them to understand that modern equipment originates from far simpler tools that were invented by people hundreds of years ago to travel as securely as they could and to navigate through the sea, thus realizing the strong connection between the old and the new. Knowing about the history of their profession also allows them to understand that science and human activity are inextricably linked, because all human inventions are created by people who live within societies who were influenced by the circumstances of their time, and they are not just intellectual mechanisms independent of human experiences, ideologies, beliefs, and aspirations [11]. Thus, learning about ancient marine technology is in reality a lesson on the history of the people behind the inventions, who tried and succeeded in understanding how nature works and developed tools to exist within it, both in and out of the sea.

Based on these guidelines, we introduce through a combination of museum education and gamification, a completely new approach to the connection of students of Maritime Specialties with the history of seamanship. The teaching model we are proposing could be applied from the first grade of the Vocational High School, in the context of general education and introduced in the form of an exploratory project, concerning the approach of historical knowledge and references that focus on the scientific historicity of Maritime Studies in the technical education of Greece through museum education and gamification.

IV. STATE OF ART: GAME FOR VOCATIONAL EDUCATION AND TRAINING

The gamification models that we have applied in the curricula of the specialties in vocational education and training are based on the one hand on the intentionality of knowledge of the specialty of the technical school [12] and the other hand on the concept of the zone of proximal development regarding the orientation of graduates [7]. Thus, we have seen in technical education a wide range of options, from games that are included in micro-scenarios and oriented towards learning a specific component [13] to game platforms related to learning and operating structures and algorithms [14] or games in even more complex forms such as digital escape rooms [15].

The ultimate goal of our proposal is to revise the unilateral epistemological attitude of the students of Maritime Studies. The teaching model that we propose in this article is focused on the ability to logical communication with the student of maritime studies in a vocational high school. The intentionality of knowledge and the unilateral vocational orientation of students in vocational high schools require a critical approach to the existing curriculum [16]. This critical reflection is about whether a historical and scientific orientation can influence students positively toward their ultimate professional goals. As research suggests, context and history are important in connecting science with practice by storytelling and historical perspectives are missing from VET classrooms. Additionally, by learning about the history of their future profession, students can comprehend the nature of discovery and the fact that it is a continuous process associated with hard work and without a guarantee of success, hence highlighting the need for persistence in one’s endeavors [17]. Through this process, the students will also recognize the human factor behind every scientific discovery and invention in their field of study.

An alternative critical program that strives to correlate the overall frame of reference (curriculum) could be applied from the First Grade of Vocational High School. Moreover, always in the context of general education and historical memory, an exploratory project that would involve the approach of historical knowledge and museum references through museum education practices and gamification could be introduced, which would focus on the scientific historicity of maritime studies for technical education in Greece. The central scientific and pedagogical question is whether integrating references to the past of seamanship as history into the curriculum of students will contribute to the development of their cognitive interests [11]. From this point onwards, the question is extended regarding the transition from knowledge-centered development to an interest in the very nature of man, the need to broaden one’s horizons, and to ‘reach’ new territories: elements which are also structural components of the seafarers’ psychosynthesis.

V. THE MARITIME TRADITION MUSEUM IN PERAMA AS AN INSPIRATION FOR A WEB GAMIFICATION PLATFORM

The Maritime Tradition Museum is located in Perama near Greece’s largest port, Piraeus. Piraeus since the 5th century B.C. has been used both as a strategic naval base and as the center of Mediterranean trade [18], and to this day is one of the largest ports internationally. The Museum was founded in 1992 and since 2014 it has moved to its current location in Perama as shown in Fig. 1. It hosts a
plethora of exhibits related to Greece’s Maritime History from ancient to modern times [19].

It seems appropriate that students who have chosen the Maritime Sector should have some basic knowledge of the history of their chosen field so that they can better comprehend its importance by realizing the timeless character of seamanship, its significance for Greek socioeconomic reality, and the evolutionary trajectory of marine technology from astrolabes and sundials to GPS and modern satellite equipment, and from triremes to modern warships.

A first, introductory visit the museum is a fine way to interact with the exhibits and the space as well as to participate in the educational programs that take place there. Since museums are more informal places than classrooms, they are a great environment for introducing students to history [4]. After they visit the museum, the students will have some previous knowledge that they can build on while playing the game, in the spirit of constructivism that permeates museum education programs [3].

Both visiting the Maritime Tradition Museum and playing the game are important for the successful retaining of knowledge for VET students, whose needs are rarely addressed by museums. The gamified environment will work both as a learning tool and as a reminder of the information they accumulated there.

VI. THE GAME – DESIGN AND IMPLEMENTATION

The game is a quiz accompanied by a virtual space, with selected museum exhibits of ancient Greek and byzantine marine technology, in which students will search for answers to its questions. It is hosted on the website (https://sites.kotsifakos.mysch.gr/university/students/master/3/), which focuses on ancient seamanship. We created this website (Fig. 2, 3) inspired by the Museum, with the purpose to accompany and enrich the pedagogical activities that took place there with Vocational High School students during the 2021–2022 school year. The website contains information on both those activities and important museum exhibits of ancient marine technology along with the game. The game itself consists of two interconnected parts, the virtual space, and the quiz.

The virtual reality (VR) space was created in Artsteps [20], a web platform for creating VR exhibitions in which anyone with a free account can design a virtual space, either manually or using the free templates, and decorate it with pictures, videos, text, and 3D objects. The virtual space is embedded in the game’s website and students can explore it freely, without having to create an account. In this space, we have incorporated digital images of selected tools of ancient marine technology displayed in the Museum. The students are free to explore them and read the information we have added for each one in their descriptions (Fig. 4–6).
Also, our main aim is to make sure that students pay attention to substance, read each description while searching for correct answers, and understand the links between ancient & modern tools.

The accompanying quiz was created in Google Forms, an online tool from Google to create and share online forms and surveys and analyze responses in real-time as shown in Fig.7.

The students will have to complete it using information they obtained in the virtual space and answer with the correct code. The quiz's questions are posed as hypothetical scenarios where students have to figure out, by reading the description of modern tools of marine technology and their functions, which ancient tool displayed in the VR space matches its modern counterpart, resulting in their understanding of how each ancient tool was used by linking it to a modern one they are more familiar with.

For example, the following is a question/scenario from the quiz: “Nowadays, the use of GPS has made our lives easy, and navigation is accurate & secure by the use of satellite technology. Imagine you were part of a ship’s crew in the 2nd century B.C., which instrument /tool would you use to figure out your location that would help you reach your destination? Find the answer in the Virtual Space above and reply using the code in the correct item's description. (Pay attention to dates (Fig. 8)). All the other questions are in the same format.
The game is best to be implemented after visiting the Museum in person, and it is in no way a substitute for the visit, but it has a complementary role. The students’ feedback after the visit and the activities that took place there were positive. The students seemed eager to repeat it. During the game, they can either work alone or in teams of two (if the computers in the lab are not enough for each student to use one) while the teacher has an assisting role. He or she lets them explore the space freely on their own, interact with the exhibits and solve the quiz on time, and only interferes if the students ask for help.

VII. EXPECTED RESULTS – EVALUATION

Since Vocational High School students are not taught history of any kind, their previous knowledge about ancient marine technology is mostly based on what they may already know about the subject outside of their curriculum, and what they acquired during their visit to the Maritime Tradition Museum in Perama, where they saw the exhibits in person and participated in the activities there.

During the 2021–2022 school year, 120 first-grade students of a Greek Vocational High School in Perama, visited the Museum and, afterward, they played the game. After completing the game, they did seem to have a better grasp of not only ancient but also modern marine technology and the way those two are interconnected since the ancient inventions paved the way for modern technology to evolve to today’s measures. They understood the critical role sea travel and seamanship played throughout history and realized its timeless character and importance for the Greek economy and society, thereby understanding the importance of their future profession.

According to the questionnaire they completed after both activities (museum visit and digital educational game) the students’ level of satisfaction was high and they seemed eager to repeat similar activities both in the museum and at school while playing the digital game. Most questions asked the students to rate their experiences from 1 to 5, with 1 being the lowest, and 5 the highest. The vast majority (69.4%) of students enjoyed the museum visit (33.3% and 36.1% rated it with 4 and 5 respectively) (Fig. 9), accordingly, the same percentage (69.4%) enjoyed the digital game by rating it 4 and 5, but this time even more students (44.4%) gave the game the highest rating (Fig. 10).

When it comes to the exhibits of ancient seamanship that they interacted with, both in the museum and the game, 70.5% of the students reported that they were interested and enjoyed learning about them and their function (Fig. 11).

Finally, when asked if they were willing to repeat both activities 61.2% of students stated that they would like to revisit the museum and replay the game (Fig. 12).

Apart from students, we expect teachers to interact with the platform and have a better overall understanding of their student’s progress by analyzing the quiz’s results and each student’s scores they should be able to extract useful data about the level of success of the game.

VIII. CONCLUSIONS AND FUTURE WORK

The application of gamification in Greek Vocational High Schools motivates students to learn within an interactive and fun environment that strives to cultivate their creative side apart from their practical one. Gamification combined with museum education practices, even away from the Museum, seemed to be an interesting and useful method to bring students who are not familiar with the history and historical thinking into contact with them, through museum exhibits incorporated into digital educational activities such as our game. The implementation of a game that is not tedious and repetitive resulted in the students’ higher satisfaction with the learning process and it seemed to enhance their problem-solving skills, memory-retaining ability, and computer fluency [13].

From the data gathered so far, the approach of introducing VET students to the history of their chosen field by implementing digital games inspired by relevant museums as educational tools seems promising. Further researching this approach may enrich the VET curriculum because students who, accept practical knowledge about their future professions, also have a theoretical background, consequently, they will also have a better understanding of its significance and its impact on the socioeconomic spectrum, thus becoming better professionals and citizens.

The directions of alternative critical design are mainly relevant for students at vocational high schools following
the maritime professions sector but could be developed for other engineering-related specialties as well.

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CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interest.

REFERENCES


Kotsifakos Dimitrios is a Ph.D. holder and post-Doc researcher, in the Department of Informatics at the University of Piraeus, Greece. He also holds an MSc in Informatics from the University of Piraeus, awarded with Distinction (2010), and holder of a four-year degree in Electronic Engineering from the Technological Educational Institute (A-TEI) of Athens (1990). In 2012, he completed a one-year Pedagogical Training Program and in 2022 he completed a Specialization Program in Counseling & Career Guidance at the School of Pedagogical and Technological Education (ASPETE) in Athens. Dr. Kotsifakos has participated in seminars, and training programs related to Electronics, Informatics, and Electrical Studies as well as in international and Greek conferences. He is appointed as a Secondary School Teacher of Electronics (Vocational Education and Training, VET). He is especially active in innovative actions concerning the educational process and he has received awards for the cultural programs he has developed. He is the father of four children. Dr. Kotsifakos taught with professor Douligeris web technologies (“World Wide Web and Digital Collections Management”) in the MSc “Digital Culture, Smart Cities and IoT”, at the Department of Informatics, University of Piraeus, Greece.

Maria Gerasimoula Karali is a postgraduate student in the MSc “Digital Culture, Smart Cities and IoT”, at the Department of Informatics, University of Piraeus, Greece. She also holds a BA in Archaeology and History of Art from the University of Athens (2020).

Eirini Katsola is a postgraduate student in the MSc “Digital Culture, Smart Cities and IoT”, at the Department of Informatics at the University of Piraeus. She also holds a four-year degree in History, Archaeology, and Cultural Resources Management from the University of Peloponnese (2019). Also, she has attended seminars and training programs related to Digital Culture and other Digital Skills. She is currently working as a volunteer at Goulandris Natural History Museum in Athens.

Achilla Kravouri is a graduate student from the Department of History and Archaeology of the University of Ioannina (2020). At this moment, she is doing her Master’s degree in “Digital Culture, Smart Cities and IoT” at the Department of Informatics, at the University of Piraeus. She, also, attends various seminars related to new technologies.
Christos Douligeris, currently a professor at the Department of Informatics, University of Piraeus, Greece, held positions with the Department of Electrical and Computer Engineering at the University of Miami. He was an associate member of the Hellenic Authority for Information and Communication Assurance and Privacy and the President and CEO of Hellenic Electronic Governance for Social Security SA. Dr. Douligeris has published extensively in the networking scientific literature and he has participated in many research and development projects. His main research interests lie in the areas of computer networking, communications, network security, cyber security, web science, data analytics, new technologies in education, and emergency response operations.