

MYTH TROUBLES: An open-source educational game in Scratch for Greek

Mythology

Olympia Evangelopoulou, Stelios Xinogalos

Abstract

Background. Educational games are nowadays used for facilitating the teaching and learning process of various subjects. History is one of the subjects that simulations and games are used for promoting active learning and supporting students in comprehending various history-related subjects.

Aim. This article reports on a new educational game on Greek mythology, called MYTH TROUBLES, designed and developed from scratch with the aim of supporting primary school students in studying Greek mythology and raising their interest on the subject of history.

Method. The article presents the educational rationale and design of MYTH TROUBLES in the context of an educational games design model proposed in the literature. Since the game was implemented with the platform of Scratch and it is available online both for students (or anyone interested in Greek Mythology) and game developers, some information for its implementation is also provided. The results of a pilot evaluation of MYTH TROUBLES with the help of 21 experienced school teachers are presented, along with proposals for improvement and extension of the game.

Results. Teachers evaluated positively MYTH TROUBLES in terms of acceptability, usability, utility as an educational tool, as well as its interface and game play and expressed their willingness to use it in the classroom.

Conclusions. MYTH TROUBLES is considered appropriate by teachers for supporting the teaching and learning of Greek mythology and assessing its educational value in class is the next step. Scratch is appropriate for implementing such educational games and sharing them with interested players and game developers.

Keywords

Educational games, history, Greek mythology, Scratch, evaluation

Basic Data

Instructional Objectives:

- Raise students' interest in Greek mythology and history in general.
- Engage students' interest in the classroom and promote active learning.
- Support primary school students in self-studying Greek mythology and self-assessing their knowledge.

Game Objectives:

- Help Damocles, a farmer in ancient Greece, find Zeus (the father of Gods) at Olympus mountain and beg him to send rain and save his fields from drought.
- Guide Damocles through his quest in order to avoid arrows and collect coins, find Zeus's lost thunderbolts and acquire Hermes's golden sandals to fly to Olympus.

- Study carefully the narrations provided in the history pages in order to answer correctly the multiple choice questions posed by the ancient book of mythology and acquire the necessary equipment for continuing the journey.

Debriefing Format:

Debriefing is important for educational games and simulations (Crookall, 2014; Kriz, 2010). Crookall (2014) highlights the importance of engagement both during the simulation/game and debriefing in learning. In MYTH TROUBLES debriefing takes place at each level of the game through the multiple choice questions posed to students, who are informed immediately for the correctness of their answers. Damocles, guided by the student, interacts with the book of mythology that poses him with questions which must be answered correctly in order to continue. This quiz is part of the scenario in order to motivate and engage students. Moreover, the student can take the time needed and iterations (going back to study the recorded narrations and repeating the quiz) are possible in order to achieve proper debriefing (Crookall, 2014). In case of using the game in class, a discussion between all students and the teacher can take place. The teacher can pose questions regarding students' feelings and emotions during the game, their perceptions and thoughts about the activity and the knowledge gained (Kriz, 2010), as well as students' achievements in the game (score). Both types of debriefing are considered important. The computer-based quiz provides opportunities for self-assessment and highlights the need for further study, while discussion between the teacher and students can help the latter to fill gaps in their knowledge. Moreover, the teacher can assess students' acquired knowledge and realize if and how the game contributes in supporting students both in studying and raising their interest in history.

Target Audience:

Primary school students or anyone interested in Greek mythology.

Preparation and set-up Time:

If computers with Internet access and a browser with Adobe Flash Player plug-in are available no preparation is needed. Otherwise the desktop version has to be copied to students' computers.

Playing Time:

The playing time depends heavily on two factors: whether the players have studied the relevant material prior playing or they are going to study by listening to the narrations incorporated in the game; whether the players will play a single level of the game or the full version with all the levels.

Participation materials required:

All the educational material is incorporated in the game:

<https://scratch.mit.edu/projects/91389755/>

Introduction

Educational games are considered important for the teaching and learning of various subjects nowadays. History is one of the subjects that simulations and games have been utilized for several years (Corbeil, 2011; McCall, 2016). In some cases simulations and games are used for other purposes than just teaching history. For example, computer history simulations can be used for promoting active learning in the field of understanding international politics and relations (Weir & Baranowski, 2011).

In this article, a new game on Greek Mythology, called MYTH TROUBLES, is presented. MYTH TROUBLES was designed and implemented in the context of the

MSc thesis of the first author under the supervision of the second author. MYTH TROUBLES incorporates material that is based on the school textbook used in the history course taught to 3rd grade primary school students in Greece. This is the first purely theoretical course taught in primary schools in Greece and our motivation was to provide students with a much richer educational experience and support them in self-studying and self assessment. It is clear, however, that MYTH TROUBLES can be used by anyone interested in Greek Mythology.

After considering various tools, the decision to use the Scratch platform for implementing MYTH TROUBLES was made. Scratch (Maloney, Resnick, Rusk, Silverman, & Eastmond, 2010) was considered ideal for implementing the game, since it supports all the features of the game we designed and it provides some unique opportunities for its future utilization: the game can be utilized by teachers and students worldwide through the online community of Scratch at no cost; the source code of the game is available and can be edited online by interested game designers for extending the game or changing it for creating a new game with different content and graphics; the game can be used for cross-curricular activities, that is studying history (or another subject) along with programming by extending the game or creating a new game with different content with support from the teacher. These opportunities offered by MYTH TROUBLES along with the underlying engaging scenario (game objectives) are actually its main advantages compared to other existing games that are mainly quizzes without an underlying story.

The rest of the article is organized as follows. In section 2, the analysis and design of MYTH TROUBLES is presented in the context of the educational games design model proposed by Ibrahim and Jaafar (2009). Section 3 presents some information on the

implementation of the game with the educational platform of Scratch. In section 4, the results of the evaluation of MYTH TROUBLES by teachers in terms of its acceptance, usability and utility as an educational tool (Sanchez, 2011), as well as its interface and game play are presented. Finally, some conclusions and plans for future research are presented.

Analysis and Design of MYTH TROUBLES

MYTH TROUBLES is an educational game about Greek Mythology. The protagonist is Damocles, a farmer in Ancient Greece who has a problem with his fields due to drought. Damocles decides to travel to mountain Olympus in order to find Zeus -who is the father of the Gods- and beg him to send rain. During his journey (levels of the game) Damocles has to collect coins, thunderbolts and Hermes's gold sandals for flying to the top of mountain Olympus where Gods live and avoid arrows that fall from the sky. Also, Damocles with the help of his fellow traveler (the player) has to answer correctly multiple choice questions posed by the book of Ancient Greek Mythology in order to acquire equipment necessary for his endeavor. The questions refer to Greek Mythology and the fellow traveler (player) of Damocles can study the relevant material by listening to recorded narrations as many times as needed. An overview of the most important features of MYTH TROUBLES is provided in Figure 1.

MYTH TROUBLES might be simple in conception, but as every educational game had to be carefully designed in order to be successful. Various design frameworks have been proposed for this purpose and several of them are reviewed in (Malliarakis et al., 2014). The "Educational games design model" proposed by Ibrahim and Jaafar (2009) was considered to be a good choice for the design of MYTH TROUBLES, since it is in

alignment with the main goals of this game. Specifically, “this model is designed specifically for student self-learning with integrated self-assessment modules, thus it will be a web based game that students can use during their off-lecture time” (Ibrahim & Jaafar, 2009; p. 297). The model focuses on three dimensions, namely *Game Design*, *Pedagogy* and *Learning Content Modelling* as shown in Figure 2.



Figure 1. Overview of MYTH TROUBLES

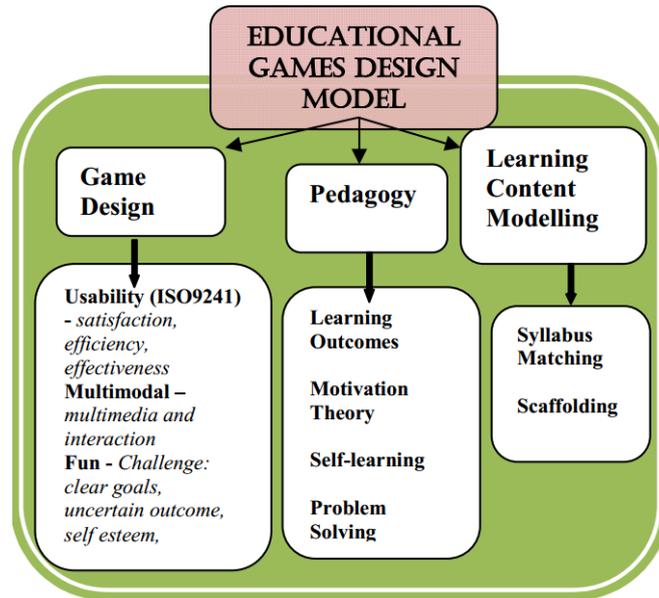


Figure 2. Ibrahim’s & Jaafar’s Educational Games Design Model Framework
 Source. (Ibrahim & Jaafar, 2009)

Game Design focuses on: *usability* in terms of effectiveness, efficiency and satisfaction with the game; *multimodal* content (e.g. text, graphics, audio, video, animation) and *interaction* between the learner and the game with immediate feedback; *fun* that is the distinctive characteristic of educational games in comparison with other learning approaches. Clear educational goals will challenge students, while the uncertain outcome will increase their curiosity and their achievements will boost their esteem.

Pedagogy focuses on the degree that the game: meets its *learning outcomes* and specifically the first three levels of Bloom’s taxonomy – knowledge, comprehension and application; supports self-learning with integrated self-assessment; *motivates* learners in comparison with traditional lecture based lessons; and promotes high order thinking skills and *problem solving*.

Learning content modelling focuses on the degree that the content incorporated and the game design matches the intended *syllabus*, since the game is designed for supporting students in self-learning specific subjects through scaffolding.

The most important design decisions taken for each factor of the *Game Design*, *Pedagogy*, and *Learning Content Modelling* dimension are summarized in Tables 1 to 3 respectively. References to other design frameworks/models that refer to the same factors with the same or a slightly different term are included.

Table 1. Game design

Factor (Ibrahim & Jaafar, 2009)	Design decision
Usability	
- Satisfaction (de Freitas & Jarvis, 2006; Malliarakis et al., 2014; Salen & Zimmerman, 2004)	The game is user-friendly and uses an interesting <i>scenario</i> and attractive graphics for primary school students. Learning all the necessary history facts through listening to recorded narrations organized in small and manageable units instead of reading long texts, and testing the acquired knowledge through playing and helping the protagonist achieve his goal gives students a feeling of satisfaction.
- Efficiency	The game can be played online through a web-browser or offline using the desktop application. All the necessary information regarding both the mechanics of the game and the various units of the Greek Mythology are incorporated in the game using mainly recorded narrations and at a lesser extent simple text.
- Effectiveness	The game is available in two modes in order to be effective: <ul style="list-style-type: none"> - for making a revision of all the curriculum content regarding Greek Mythology, or - for studying specific units of the curriculum content on isolation.
Multimodal	
- multimedia and interaction (de Freitas & Jarvis, 2006; Malliarakis et al., 2014; Salen & Zimmerman, 2004; Yusoff et al., 2009)	<ul style="list-style-type: none"> - Various objects, such as coins, thunderbolts, golden sandals, a compass, a torch and so on, must be collected by Damocles through his journey to find Zeus. Simple but at the same time attractive <i>graphics</i> were prepared for these objects, the backgrounds that have a flavor of ancient Greece and the two <i>sprites</i> (farmer and Zeus). - Brief blocks of <i>text</i> are used for introducing each unit that contains the next challenge in the journey of Damocles and a history page with the <i>recorded narrations</i>, as well as at the end of a successful challenge for informing the player for his reward (i.e. acquisition of a compass that will be used for continuing the journey). - Every time the player wins or loses Damocles informs him/her with a text bubble. - <i>Sounds</i> and background <i>music</i> are used, as well as recorded

narrations for presenting the educational content.

- The player *interacts* with Damocles using the arrow keys for moving, jumping or flying him to Olympus when he acquires the magic sandals!
- When the game finishes a *video* is used showing Zeus thanking Damocles for finding his thunderbolts. Zeus rewards Damocles by sending rain and saving his fields from drought. Finally, Damocles thanks the player for helping him in his quest!

Fun – Challenge

- clear goals (de Freitas & Jarvis, 2006; Malliarakis et al., 2014; Salen & Zimmerman, 2004)

The player has to achieve two clear goals in every level of the game in order to achieve the ultimate goal of reaching Zeus at the Olympus mountain.

 - 1) After studying at his/her own pace the relevant material (recorded narrations divided in small and manageable units) in the history pages, the player has to answer correctly at least 6 out of 10 multiple choice questions.
 - 2) The player guides Damocles in order to avoid arrows and collect coins for buying the necessary equipment for his quest, Zeus’s lost thunderbolts, or Hermes’s gold sandals for flying at the top of Olympus mountain.
- uncertain outcome (Malliarakis et al., 2014)

The player has to complete a level in order to see how the quest continues or how he/she will be rewarded, and this uncertain outcome keeps his/her *interest* intact.
- Self esteem

The existence of *score* and the *rewards* after the successful completion of a level aims at creating a feeling of self esteem, as well as for providing motivation for more rigorous studying. Moreover, the player (student) is encouraged to keep on trying to finish the game, since the game does not end after an unsuccessful effort. Instead the player can repeat the level as many times as needed for completing it.

Table 2. Pedagogy

Factor (Ibrahim & Jaafar, 2009)	Design decision
Learning Outcomes (de Freitas & Jarvis, 2006; Malliarakis et al., 2014; Salen & Zimmerman, 2004; Yusoff et al., 2009)	<p>The main goal of the game is to motivate Primary School children and raise their <i>interest</i> in the course of History, which is the first purely theoretical course students are taught in the 3rd grade in Greece.</p> <p>The six levels of the game are in alignment with the first six chapters of the <i>school textbook</i> on History, while it can be used for self-studying the units of each chapter at home, making a revision of a whole chapter that contains a great deal of myths or all the chapters. Finally, the game can be used at school for raising students’ interest and making the lesson more appealing to them.</p>

Motivation Theory (de Freitas & Jarvis, 2006; Malliarakis et al., 2014)	MYTH TROUBLES helps students study and self-assess their knowledge through playing and this motivates them to study more consciously in order to achieve a <i>higher score</i> and manage to <i>finish</i> the game.
Self-learning	As already mentioned, the game was designed so as to promote self-learning by providing narrations with all the important content that teachers want children to remember from a rather extended -for their age- text. Students can repeat <i>listening</i> the history pages and answering the quizzes as many times as they want and at their own pace.
Problem Solving (Malliarakis et al., 2014)	After studying each history page the students have to prove their knowledge by answering correctly the <i>multiple choice questions</i> posed by the book of mythology.

The intended results of utilizing MYTH TROUBLES (presented in Table 2) form a hierarchy of learning outcomes, as shown in Figure 3. MYTH TROUBLES has been designed so as to be utilized by students for self-studying and self-assessment. So, if there is no infrastructure at school, students can utilize the game at home. If this is the case, the role of the teacher is considered important in terms of motivating students to use the game in the first place. In the case that the game is used at classroom the teacher can help in achieving the ultimate goal of cultivating students' interest in mythology and history through debriefing after finishing the game. The discussion with students will also give the teacher the ability to measure the results in each level of the presented learning hierarchy.

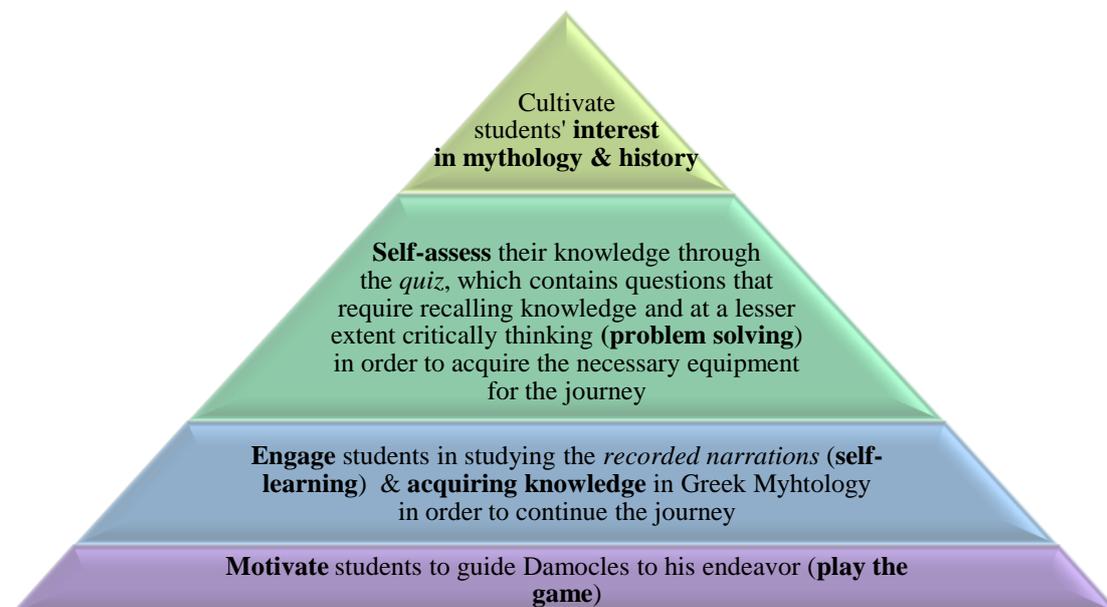


Figure 3. Hierarchy of learning outcomes.

Table 3. Content modelling

Factor (Ibrahim & Jaafar, 2009)	Design decision
Syllabus Matching (Malliarakis et al., 2014; Salen & Zimmerman, 2004; Yusoff et al., 2009)	The content of the game was based exclusively on the material of the first six chapters of the history <i>school textbook</i> used at the 3 rd grade of Primary School in Greece.
Scaffolding (Malliarakis et al., 2014; Yusoff et al., 2009)	Knowledge is acquired progressively through playing. The player studies at his/her own pace the narrations that summarize all the important material from the school textbook and if the self assessment is not successful he/she returns back to studying. The material is presented in small and manageable units for avoiding repeating what is already known.

Implementation of MYTH TROUBLES

Nowadays, a great number of game engines, programming languages and tools are available for implementing games. MYTH TROUBLES was implemented using Scratch 2.0 (<https://scratch.mit.edu>), a free platform created by the Lifelong Kindergarten Group of the MIT Media Lab. Scratch gives the opportunity of creating

interactive games, stories and animations with attractive interfaces, while no specialized programming skills are required (Maloney et al., 2010). Scratch is mainly used for introducing novices to programming, as well as promoting *computational thinking* through its puzzle-like interface for coding error-free programs. The environment offers an online and an offline editor and an online community with millions of users sharing and remixing projects. Scratch is used at all levels of education (from elementary school to college) across diverse fields, such as computer science, math, language arts, social studies and interdisciplinary projects. Although we were not able to locate an educational game with the features we wanted to implement in MYTH TROUBLES in the Scratch gallery, the environment seemed to be a good choice for a number of reasons:

- the game could be played by students online through a web browser, without the need of installing it
- the game could be easily made available to millions of users
- the game could be easily extended by anyone interested in it, as the source code is freely available online
- Scratch is one of the most popular tools used in Primary Schools for introducing students to programming, or better to computational thinking. In this sense, MYTH TROUBLES could be used for cross-curricular activities, such as: studying history along with programming by extending the game; studying another subject along with programming by creating a new game using MYTH TROUBLES as the basis.

An important and time consuming part of developing MYTH TROUBLES was creating the storyboard of the game, designing or finding the necessary free graphics, recording the narrations and finding the appropriate background music and sounds. Damocles and Zeus (Figure 4), the main game characters, were designed by the first author of this article, while the rest of the graphics are free vector graphics (<http://www.freepik.com/>), edited in order to fit with the rest of the game. Free music and sounds were utilized (<http://freemusicarchive.org/>, <https://www.freesound.org/>, <http://soundbible.com/>).



Figure 4. Damocles and Zeus, the protagonists of MYTH TROUBLES

MYTH TROUBLES, in terms of the Scratch project developed, consists of 188 elements:

- 72 Scratch objects (buttons, 5 different versions of the main character, Zeus, coin, arrow, thunderbolt, the sandals of Hermes, mythology book).
- 37 stages (scenes)
- 7 variables (e.g. counting points)
- 12 lists (6 lists with questions and 6 with the answers)
- 606 scripts

In Figure 5, an example of a script coded in Scratch for moving Damocles with the arrow keys from the keyboard is indicatively presented.

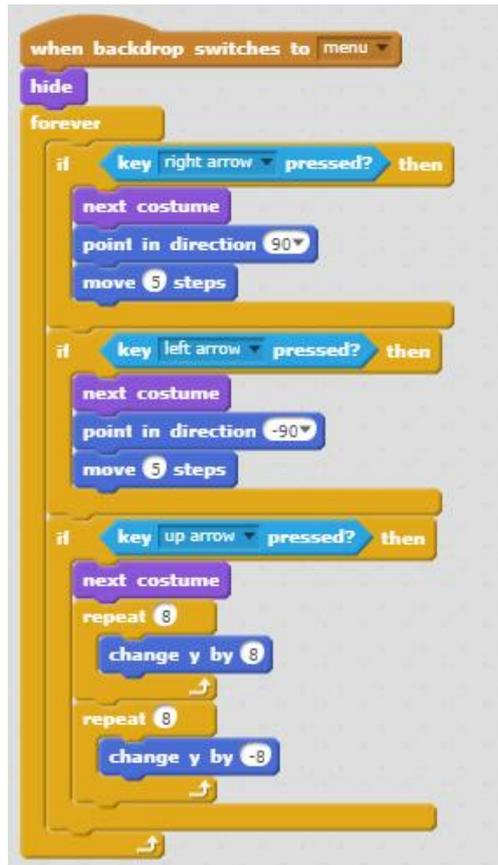


Figure 5. An example of a script in Scratch for moving Damocles

Evaluation of MYTH TROUBLES

In order to evaluate the game in terms of its acceptance, usability and utility as an educational tool, a questionnaire was prepared and filled in mainly by Primary school teachers. In this section the methodology used, demographics about the participants, as well as the results of the evaluation are analyzed.

Methodology

Initially, a questionnaire was prepared based on the criteria proposed by Sanchez (2011) and were partially based on the work of Aldrich (2009) for evaluating the following dimensions of a game:

- The *acceptability* of a game by students, teachers and the institution. Actually, in this dimension the added value of the game in the learning process is evaluated.
- The *usability* of the game in terms of technical and pedagogical factors that affect the possibility of using the game in the learning process.
- The *utility* of the game in terms of its educational aspects and the expected learning outcomes.

Besides the questions included for these three dimensions, some questions were also included for studying elements of the interface and game play, as well as some general questions regarding the usage of educational games in the classroom.

The questionnaire included 22 ordinal questions, with a scale from 1 to 5 (1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree), 2 close-ended “Yes/No” questions and an open question for further feedback/comments on the game. Subsequently, the questionnaire was distributed in printed and digital form. Eventually, 21 people played the game MYTH TROUBLES and answered the game's evaluation questionnaire. Descriptive statistics are used for the quantitative analysis of data. Specifically, the following values are calculated and presented in tabular form: mean; standard deviation; frequency and percentage for each possible response in every question. Reference codes for each question are used for easier reference of the results in the text (Tx.y where x=number of table and y=number of question).

Participants

This research has been conducted following the ethical requirements established by Greece national board of ethics. The participants that played and evaluated voluntarily

and anonymously the game were all adults working in the education sector and more specifically had the following specialization:

- 1 archeologist who is particularly interested in Greek mythology as well as drawing comics on the topic
- 1 kindergarten teacher
- 2 philologists
- 1 informatics primary school teacher
- 16 primary school teachers

Results

The game was evaluated based on 4 key dimensions: acceptance, usability, utility as an educational tool, interface and game play. The results obtained are quite satisfactory.

Regarding the dimension of *acceptance* of the game (Table 4), the evaluation showed that the participants consider that the content is relevant and without errors (T4.1: Mean=4.9, SD=0.22), while the narratives and questions are estimated to satisfy the expectations of the students (T4.2: Mean=4.3, SD=0.73). Furthermore, 81% of the respondents strongly agree that the content of the game fits the characteristics of the students (T4.3: Mean=4.7, SD=0.72) and 75% of them strongly agree that the content is relevant to the history textbook of the 3rd grade of Primary School (T4.4: Mean=4.8, SD=0.44). Finally, based on the replies, it seems that the time required for the game could probably allow its use in the classroom (T4.5: Mean=4.6, SD=0.74).

Table 4. Acceptance of the game

Reference code	Question	N	Mean	Standard Deviation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
T4.1	The content is relevant (no errors)	21	4.9	0.22	-	-	-	5% (1)	95% (20)
T4.2	The content fits the expectations of the students	21	4.3	0.73	-	-	14% (3)	38% (8)	48% (10)
T4.3	The content fits the characteristics of the students (age, prior knowledge etc.)	21	4.7	0.72	-	5% (1)	-	14% (3)	81% (17)
T4.4	The content fits the curriculum of the third grade's history book referring to Greek mythology	20	4.8	0.44	-	-	-	25% (5)	75% (15)
T4.5	The time devoted to play the game allows its use in class	21	4.6	0.74	-	5% (1)	-	24% (5)	71% (15)

The results regarding the *usability* dimension of the game are presented in Table 5. The vast majority (81%) of the respondents strongly agree that the game provides sufficient guidance (T5.3: Mean=4.7, SD=0.64), while nearly all the respondents (91%) strongly agree that the game provides adequate help (T5.7: Mean=4.9, SD=0.48). Furthermore, most of the respondents agree (29%) or strongly agree (62%) that the game provides relevant and clear feedback (T5.4: Mean=4.5, SD=0.68). Regarding the utilization of the game, the respondents believe that the game can be used both at school (T5.5: Mean=4.8, SD=0.7) and at home for self-studying (T5.5: Mean=4.8, SD=0.4). As for the underlying technology and whether the game could be played in school devices or in students' personal ones, there was a range of answers with the 29% of the respondents being neutral. This probably stems from the fact that the players were ignorant of the

existence of the game's desktop application which does not require an internet connection.

Table 5. Evaluation of the game's usability (ergonomy, technology, pedagogy)

Reference code	Question	N	Mean	Standard Deviation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
T5.1	The game runs on school devices or students' personal devices	21	4.3	0.91	-	-	29% (6)	10% (2)	62% (13)
T5.2	The time devoted to learning how to use the game is reasonable	21	4.9	0.36	-	-	-	14% (3)	86% (18)
T5.3	The game provides guidance	21	4.7	0.64	-	-	10% (2)	10% (2)	81% (17)
T5.4	The game provides clear and relevant feedback	21	4.5	0.68	-	-	10% (2)	29% (6)	62% (13)
T5.5	It is possible for the game to be used at school	21	4.8	0.7	-	5% (1)	-	10% (2)	86% (18)
T5.6	The game can be used for supporting students in self-studying	21	4.8	0.4	-	-	-	19% (4)	81% (17)
T5.7	The game provides adequate help	21	4.9	0.48	-	-	5% (1)	5% (1)	91% (19)

Regarding the utility of the game as an educational tool (Table 6), the vast majority of the respondents (90%) agrees or strongly agrees that the game is suited to the pedagogical objectives of the teacher (T6.1: Mean=4.6, SD=0.67), while all of them agree or strongly agree that the game's tasks are relevant to the school's curriculum. What is even more important is that the respondents agree or strongly agree that students are expected to improve their knowledge through the game (T6.3: Mean=4.8, SD=0.4) and develop relevant competencies (T6.4: Mean=4.6, SD=0.67).

Table 6. Evaluation of the game's utility as an educational tool

Reference code	Question	N	Mean	Standard Deviation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
T6.1	The game is suited to the pedagogical objectives of the teacher	21	4.6	0.67	-	-	10% (2)	19% (4)	71% (15)
T6.2	The tasks of the students within the game are relevant to the curriculum	21	4.7	0.48	-	-	-	33% (7)	67% (14)
T6.3	By playing, students improve their knowledge	21	4.8	0.44	-	-	-	24% (5)	76% (16)
T6.4	By playing, students develop relevant competencies	21	4.6	0.67	-	-	10% (2)	19% (4)	71% (15)

The results regarding the interface of the game and game play are summarized in Table 7. All the respondents, with just one exception, consider the game interface to be both attractive (T7.1: Mean=4.7, SD=0.58) and user-friendly (T7.2: Mean=4.8, SD=0.54). In addition, all of the respondents agree or strongly agree that the scenario of the game will raise students' interest (T7.3: Mean=4.7, SD=0.48) and its elements (such as coins, thunderbolts, etc.) will keep it intact (T7.4: Mean=4.6, SD=0.51). Also, the game is considered to provide students motivation for studying and self-assessment (T7.5: Mean=4.6, SD=0.75). Finally, there is a balance between the different elements of game play and the achievement of the underlying educational goal (T7.6: Mean=4.6, SD=0.74).

Table 7. Evaluation of the interface and game play

Reference code	Question	N	Mean	Standard Deviation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
T7.1	The game interface is attractive to students	21	4.7	0.58	-	-	5% (1)	24% (5)	71% (15)
T7.2	The game interface is user friendly for students	21	4.8	0.54	-	-	5% (1)	14% (3)	81% (17)
T7.3	The story of the game (Damocles and his adventurous journey towards Mount Olympus) raises the interest of the students	21	4.7	0.48	-	-	-	33% (7)	67% (14)
T7.4	The elements of the game (collecting coins, avoiding bows etc.) keep the students' interest intact	21	4.6	0.51	-	-	-	43% (9)	57% (12)
T7.5	The game interface provides incentive for students to study (through the narratives) and raises the students' self-assessment (by answering the questions correctly)	21	4.6	0.75	-	5% (1)	-	29% (6)	67% (14)
T7.6	There is balance between the elements of the game and the achievement of the educational objective of the game	21	4.6	0.74	-	5% (1)	-	24% (5)	71% (15)

Generally, each one of the 4 dimensions of the game was positively evaluated, with the mean for each dimension ranging from 4.3 to 4.9 and the mean of all 4 dimensions being 4.67.

In the two “yes/no” questions, all the respondents expressed the belief that educational games can be used at school classes to enhance the teaching process and expressed their willingness to use MYTH TROUBLES in the history lesson.

In the open-type questions 5 respondents commented on the game. Some interesting improvements and extensions were proposed for the game:

- Enhancing the game with *more tasks and assessment of information* by students that are familiar with computers and games.
- It would be nice, if the character was speaking, so that *children with learning disabilities* can understand the game, too.
- The player could be rewarded in *voice* or be informed about failure with a *funny sound*.
- The game could have not only questions that are application exercises (Bruner) but also at a higher level such as critical thinking, synthesis and abstraction.
- The elements of the game could vary more.

Conclusions

MYTH TROUBLES is an educational game on Greek Mythology designed especially for primary school students. MYTH TROUBLES was evaluated by 21 primary school teachers in terms of its acceptance, usability, utility as an educational tool, interface and game play. The participants of the study had knowledge of the school textbook that the game was based on, the corresponding primary school history lesson and the typical teaching approach utilized in primary schools for teaching history. The results of this evaluation were rather positive, while interesting proposals for extensions were recorded. The acceptance of the game by teachers and their intention to utilize it in the

classroom is considered important taking into account the skepticism of instructors to incorporate games in their courses. Teachers' evaluation of the game is considered important and trustworthy in terms of the content incorporated, its usability and suitability as an educational tool for the target audience. It is clear, however, that the game has to be assessed by students as well in order to evaluate its acceptance and actual educational value.

The decision to implement MYTH TROUBLES in Scratch proved to be a good decision. Not only students can play online the game from any computer having an Internet connection, but the source code of the game is available to anyone that would like to extend the game or use it as the basis for incorporating material even for another course. Although the educational material incorporated in the game is in Greek the user can select the language (more than 40 languages are supported) that will be used in the online editor for presenting the source code.

Acknowledgment

We would like to thank Timothy Clapper who managed this article, including the blind review process, as well as the reviewers for their instructive comments. We would also like to thank the participants of the pilot study of MYTH TROUBLES.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

Aldrich, C. (2009). Learning online with games, simulations, and virtual worlds: Strategies for online instruction. San Francisco, CA: Jossey-Bass.

- Corbeil, P. (2011). History and simulation/gaming: Living with two solitudes. *Simulation & Gaming*, 42(4), 418-422. doi: 10.1177/1046878108325440.
- Crookall, D. (2014). Engaging (in) Gameplay and (in) Debriefing. *Simulation & Gaming*, 45(4-5), 416-427. doi: 10.1177/1046878114559879.
- de Freitas, S., & Jarvis, S. (2006). A Framework for Developing Serious Games to meet Learner Needs. Interservice/Industry Training. *Simulation and Education Conference*, Orlando, Florida.
- Ibrahim, R., & Jaafar, A. (2009). Educational games (EG) design framework: combination of game design, pedagogy and content modeling. In *Electrical Engineering and Informatics*, 2009. ICEEI'09. International Conference on (Vol. 1, pp. 293-298). IEEE. doi: 10.1109/ICEEI.2009.5254771.
- Kriz, W. C. (2010). A systemic-constructivist approach to the facilitation and debriefing of simulations and games. *Simulation & Gaming*, 41(5), 663-680. doi: 10.1177/1046878108319867.
- Malliarakis, C., Satratzemi, M., & Xinogalos, S. (2014). Designing educational games for computer programming: A holistic framework. *Electronic Journal of e-Learning*, 12(3), 281-298.
- Maloney, J., Resnick, M., Rusk, N., Silverman, B., & Eastmond, E. (2010). The scratch programming language and environment. *ACM Transactions on Computing Education (TOCE)*, 10(4), 16. doi: 10.1145/1868358.1868363.
- McCall, J. (2016). Teaching history with digital historical games: An introduction to the field and best practices. *Simulation & Gaming*, 47(4), 517-542. doi: 10.1177/1046878116646693.

Salen, K., & Zimmerman, E. (2004). *Rules of play: Game design fundamentals*. MIT press.

Sanchez, E. (2011). Key criteria for Game Design. A Framework. IFE/Ecole Normale Supérieure, de-Lyon, France.

Yusoff, A., Crowder, R., Gilbert, L., & Wills, G. (2009). A conceptual framework for serious games. In *Advanced Learning Technologies, 2009. ICALT 2009. Ninth IEEE International Conference on* (pp. 21-23). IEEE. doi: 10.1109/ICALT.2009.19.

Weir, K., & Baranowski, M. (2011). Simulating history to understand international politics. *Simulation & Gaming*, 42(4), 441-461. doi: 10.1177/1046878108325442.

Author Biographies

Olympia Evangelopoulou has a bachelor's degree in Library and Information Science from Alexander Technological Institute of Thessaloniki, as well as an M.Sc in Information Systems from University of Macedonia. Furthermore, she studied Comics, Digital Illustration, Figure Sculpting, 3D Art and Animation Elements at Comink Laboratory of Liberal Studies in Thessaloniki. Since 2016, she works as a graphic designer in a digital media advertising company.

Stelios Xinogalos (PhD, University of Macedonia, 2002) is an assistant professor at the Department of Applied Informatics, University of Macedonia, Greece. His research interests include Serious Games, Programming Environments and Techniques, Object-oriented Design and Programming, and Educational Programming Environments. He has published more than 70 peer-reviewed articles in international journals, conference proceedings and books.