

Students' Evaluation of the "Web Technologies" Android Application for Higher Education

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Abstract—The use of mobile devices in tertiary education is an emerging trend which introduces new ways of teaching and learning. In this paper, we present the implementation and the evaluation of an educational application, named WebTech. The goal of WebTech is to support the course Web Technologies, which is taught in the first semester in the Department of Informatics at the University of Piraeus – Greece, through the use of smartphones and tablets and by employing game features. The evaluation of WebTech, among others, indicated an easy-to-use, stable and quite efficient application, which does not increase the user's cognitive load.

Keywords—Education, Mobile Devices, Android Application, Games in Education

I. INTRODUCTION

The continuous technological development provides new opportunities in creating innovative teaching and learning environments, and sets new foundations in the educational process. In the recent years, mobile applications are becoming increasingly important in higher education [1], given that smartphones and other mobile digital devices, such as tablets, can be surprisingly useful didactic resources for developing subjects in both distance and face-to-face university studies [2].

Mobile Learning as a model of e-learning, refers to the acquisition of knowledge, skills and attitudes by utilizing mobile technologies [3]. Mobile devices enable individuals to learn whatever they wish to learn and whenever it suits them to do so [4]. Thus, with the integration of mobile devices in education and the creation of a wide range of applications that can be implemented in the educational reality, the role of mobile devices in the educational process changes by promoting a combination of education and entertainment at the same time. Research has shown that these types of applications can also improve the students' learning achievements and provide a positive pedagogical experience [5]. The easy-to-use features combined with the fast learning curves in various mobile devices has been shown to have a significant effect on the level of adoption of mobile learning by students in higher education [6].

In parallel, games are omnipresent in the current everyday life. We play games while traveling, relaxing or at work, simply to create enjoyable experiences for ourselves and others [7]. Serious games are characterized by having another purpose besides the element of entertainment: that is education and/or training [8]. Digital game-based learning has emerged as a particular research field within the wider context of education, which has attracted a considerable interest in the educational and scientific communities [9].

Many researchers have developed applications that can be used to cover specific university lessons, where mobile

devices are used by students [10][11][12][13]. Additionally, efforts have been put in creating various quiz applications for mobile devices with different content and options [14][15][16][17].

In all the previous cases, although the applications have a definitive educational character and may cover similar content, they are not suitable for implementation in Greek university courses because they are either not addressed to courses taught in these institutions or they do not comply with the curriculum of the courses. Thus, despite the wide availability of applications in most cases their use is not suitable in a wide range of university courses.

Moreover, there are still open questions like: can a mobile device application, that it is designed for the support of a specific lesson, spark the students' interest? Can an educational application for mobile devices that uses gaming features enhance student learning?

In our previous work [18], we designed and proposed the implementation of an educational application, named WebTech, for Android mobile platforms in higher education with the aim of introducing university students in web technologies principles through a more interactive and playful experience which exploits the benefits of mobile technology. The application's structure and functions were supported by appropriate pedagogical theories and framing models in order to set strong foundations for a successful design. This was a work-in-progress completed that presented the creation of the first version of the application.

More specifically, the first version of the application aims at supporting the Web Technologies course, which is taught in the first semester of the Department of Informatics at the University of Piraeus. The course's content includes the creation of web sites with the use of HTML, CSS, JavaScript and PHP technologies. The application, through its game-related structure, offers a more interactive learning experience and a content that fully complies with the objectives of the course, providing a valuable learning tool. The purpose of this application was to help students learn the course's content with an easier and fun way, enhance their knowledge and spark their interest. To ensure this, the WebTech's content consisted of four categories that fully cover the Web Technologies course's curriculum. Each category includes a quiz game with multiple choice questions, scores, help features and results reports. The user is able to choose the game category, the number of questions and receive reports over his answers.

In this paper, we present the evaluation of WebTech that was performed by university students. After a certain testing period, the students gave their opinions and suggestions through answering a questionnaire that was designed in order to evaluate the application.

This paper is organized as follows. In Section II, the technical and functional description of the developed mobile application is presented. Section III presents the research methodology and Section IV the results of the evaluation performed by students. A discussion is included in Section V, while Section VI concludes the paper and presents future research and development steps.

II. THE “WEBTECH” APPLICATION

Given that there are no pre-existing applications in the University of Piraeus for the support of the Web Technologies course, we created an application that fully meets the objectives of the course. This application is addressed to university students and aims at providing a useful supporting tool for learning and understanding the course’s curriculum content.

A. The WebTech’s Description

The initial development of the application is for the Android operating system and comes in the Greek language. The application, so far, includes multiple choice questions in the form of quizzes, separated in four different categories, following the curriculum of the course Web Technologies. The content of the application’s quizzes consists of original questions that were written from scratch and follow the course’s content.

WebTech can be installed and work on any smartphone or tablet android device. One of the basic application’s features is the menu that the user will use to select a quiz category (Figure 1).

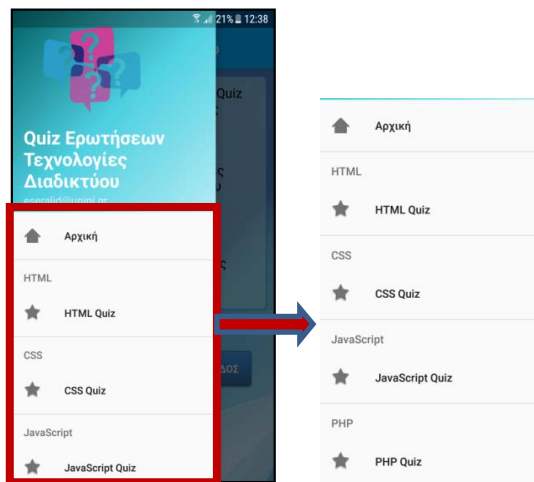


Fig. 1. WebTech’s game menu

After the initialization of a specific quiz category each question is presented in a multiple-choice answer form and the user can either move on to the next question or receive help (Figure 2).

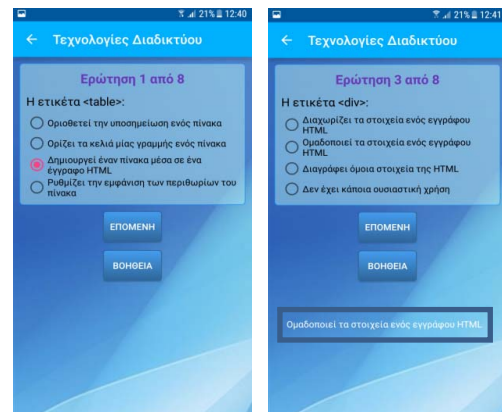


Fig. 2. WebTech game - multiple choice question and help (in Greek)

The user after completing a quiz receives appropriate feedback (Figure 3) by seeing the total scores and the number of correct answers.

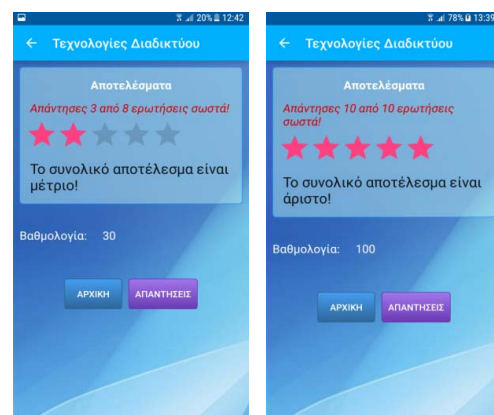


Fig. 3. WebTech results screen (in Greek)

Furthermore, the user receives feedback for each question as well (Figure 4). This comes in a list form where the user’s answer is in red letters and the correct answer in green letters. Thus, a comparison between the user’s choice and the right choice can be performed.

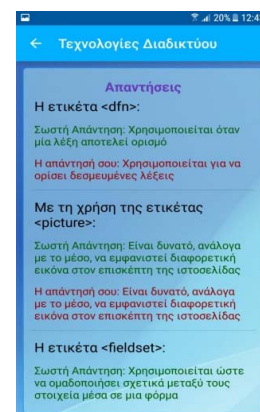


Fig. 4. WebTech answers’ screen (in Greek)

III. THE RESEARCH APPROACH

Our research took place in January 2018 at the University of Piraeus with the participation of 24 undergraduate students. The participants were students that attended the Web Technologies course, which was taught during the first semester of their studies. Even though the final software is

addressed to university students in their first year of studies, students from other years of studies participated as well.

A. Methodology and Evaluation

The purpose of this research was to gather the students' views and suggestions over the "WebTech" application as a part of a university course. Furthermore, we investigated issues of learning enhancement, and interest in learning through games and mobile devices.

Initially, we distributed the first version of Web Tech to university students that were registered in the Web Technologies course. The students were asked to install the application on their mobile devices and use it on their own time. The students used the application for over a month and after this time period they answered a structured questionnaire, giving their opinions and their suggestions considering the application's context and features.

In order to gather the students' opinions a pilot questionnaire was created for the purpose of this study, based on the authors experience [19]. The questionnaire included twenty six questions and was divided into six sections: "General Information", "Content", "Usability", "Learning enhancement", "Interest" and "Technical Specifications". The twenty two out of the twenty six questions followed a five point Likert scale which contained the following designations: 1= Strongly Disagree, 2= Disagree, 3= Undecided, 4= Agree and 5= Strongly Agree and the four remaining questions had a two-option answer (three questions had the yes/no options and one the male/female options). The total set of questions is listed below:

General Information

1. Semester
2. Age
3. Gender
4. Have you used in the past a similar application that supported a lesson's context?

Content

5. The quizzes questions are relevant with the web technologies lesson's context.
6. Theoretical and practical questions are included in the quizzes.
7. The "WebTech" application has syntax or logical errors.
8. The number of questions included in the quizzes is limited.
9. The selection of a specific lesson category is possible.

Usability

10. The "WebTech" application uses simple and comprehensible language.
11. The amount of information provided in one screen is easily manageable.
12. Navigation ease is provided through a variety of options.
13. Interaction with the "WebTech" application is simple and easy.
14. I think that the "WebTech" application is complex.

Learning Enhancement

15. I think that playing with the "WebTech" application helps me enrich my knowledge.
16. I think that playing with the "WebTech" application helps me comprehend easily the "Web Technologies" lesson context.
17. The process of feedback through the display of the right answers helps me to assimilate the "Web Technologies" lesson's content in an easier way.
18. I think it is important lessons to be supported by this kind of applications.

Interest

19. I would use the "WebTech" application again in order to learn the content of the "Web Technologies" lesson.
20. Playing with the "WebTech" application is attractive because it supports enhanced functions and graphics.
21. I feel excited playing with the "WebTech" application.

Technical Specifications

22. The "WebTech" application stopped working unexpectedly.
23. The response time for creating a new test is satisfactory.
24. There are many options and settings available.
25. Do you think that the "WebTech" application needs improvement?
26. If Yes, what are your suggestions?

The questionnaire was created electronically in the Google Forms tool in Greek and was distributed to students via email. It was open for feedback for one week and after that the results were extracted as an Excel file and the data was imported in the SPSS statistical package in order to be processed and further analyzed.

Additionally, an internal consistency reliability analysis was performed, to determine the reliability of the answer scales, using the Cronbach's alpha test. The produced value (0.943) indicated an excellent internal consistency level for the entire set of questions.

IV. RESULTS

A. Evaluation Results

The questionnaire results indicated the following data: the majority of the 24 participating students came from the 1st semester of studies. From those 15 were male and 9 were female and half of them were 18 years old (Figure 5).

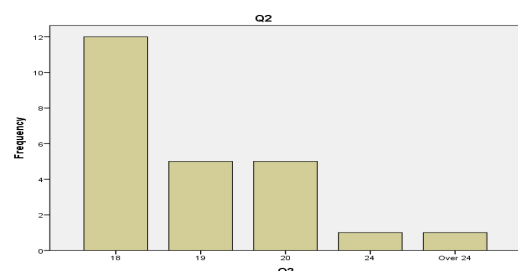


Fig. 5. Participants' ages.

The majority of the students had not used a similar mobile application for the content of a university course in the past (91.7% in no option).

In order to get an overview of the results, we present the following data which include the mean, median, mode and sum as central tendency measures and the standard deviation, variance, range and Standard Error (S.E.) of the mean as measures of variability. We also present percentages for some of the answer options for each question.

The results for the Content set of questions (questions 5 to 9) are displayed in Figure 6. In question 5, the highest percentage (54.2) is in option 5 (strongly agree), in question 6 the highest percentage (again 54.2) is in option 4 (agree), in question 7 the highest percentage (again 54.2) is in option 1 (strongly disagree), in question 8 highest percentage (45.8) is in option 1 and in question 9 the highest percentage (33.3) is in option 5.

Statistics		Q5	Q6	Q7	Q8	Q9
N	Valid	24	24	24	24	24
	Missing	0	0	0	0	0
Mean		4,08	3,79	1,75	2,00	3,50
Std. Error of Mean		,275	,248	,219	,233	,295
Median		5,00	4,00	1,00	2,00	4,00
Mode		5	4	1	1	5
Std. Deviation		1,349	1,215	1,073	1,142	1,445
Variance		1,819	1,476	1,152	1,304	2,087
Range		4	4	4	4	4
Sum		98	91	42	48	84

Fig. 6. Descriptive results for the content set of questions.

The frequency results for the Usability set of questions (questions 10 to 14) are displayed in Table I.

TABLE I. FREQUENCES RESULTS FOR QUESTIONS 10 TO 14

Questions	Percentages of answer selections (%)				
	1	2	3	4	5
10	12.5	0	12.5	37.5	37.5
11	12.5	0	16.7	41.7	29.2
12	12.5	8.3	29.2	25	25
13	12.5	8.3	12.5	16.7	50
14	66.7	25	4.2	4.2	0

The descriptive statistics for this set of questions include the following: The mean for questions 10,11,12,13 and 14 is 3.88, 3.75, 3.45, 3.83 and 1.46, respectively. The standard deviation for each of the five questions is 1.296, 1.260, 1.316, 1.465 and 0.779. The variance for each question is 1.679, 1.587, 1.732, 2.145 and 0.607. Finally, the median for each question is 4, 4, 3.5, 4.5 and 1, respectively.

The descriptive results for the Learning enhancement set of questions (questions 15 to 18) are displayed in Figure 7. For questions 15, 16 and 17 the options 4 (agree) and 5 (strongly agree) give a total answer percentage of 37.5, respectively. For question 18 the highest percentage (41.7) is in option 5.

Statistics		Q15	Q16	Q17	Q18
N	Valid	24	24	24	24
	Missing	0	0	0	0
Mean		3,88	3,83	3,83	3,88
Std. Error of Mean		,265	,274	,274	,278
Median		4,00	4,00	4,00	4,00
Mode		4 ^a	4 ^a	4 ^a	5
Std. Deviation		1,296	1,341	1,341	1,361
Variance		1,679	1,797	1,797	1,853
Range		4	4	4	4
Sum		93	92	92	93

a. Multiple modes exist. The smallest value is shown

Fig. 7. Descriptive results for the learning enhancement set of questions.

The frequency results for the Interest set of questions (questions 19 to 21) are displayed in Table II.

TABLE II. FREQUENCES RESULTS FOR QUESTIONS 19 TO 21

Questions	Percentages of answer selections (%)				
	1	2	3	4	5
19	12.5	4.2	16.7	29.2	37.5
20	4.2	8.3	16.7	37.5	33.3
21	12.5	12.5	37.5	29.2	8.3

The descriptive statistics for this set of questions include the following: The mean for questions 19, 20 and 21 is 3.75, 3.88 and 3.08, respectively. The standard deviation for each of the three questions is 1.359, 1.116 and 1.139. The variance for each question is 1.848, 1.245 and 1.297. Finally, the median value for the received answers in each of the three questions is 4, 4 and 3.

The descriptive results for questions 23 and 24 are displayed in Figure 8. For question 23 the highest percentage (41.7) is in option 4 (agree). For question 24 the opinions of students are divided between options 2 (disagree), 3 (neutral) and 5 (agree) with 29.2, 29.2 and 25 percent, respectively. Additionally, for questions 22 and 25 (that included the yes or no answer options) we had an 83.3% for the no option and a 58.3% for the yes option, respectively.

Statistics		Q23	Q24
N	Valid	24	24
	Missing	0	0
Mean		3,83	3,38
Std. Error of Mean		,260	,239
Median		4,00	3,00
Mode		4	2 ^a
Std. Deviation		1,274	1,173
Variance		1,623	1,375
Range		4	3
Sum		92	81

a. Multiple modes exist. The smallest value is shown

Fig. 8. Descriptive results for the specification set of questions.

In order to have an overview of the results we produced the following chart in Figure 9 where the mean value of each question's preferences categorized by gender is presented.

In this figure, some differences in opinions between the male and the female participants can be identified - like for example in question 20 which refers to the interaction with the application.

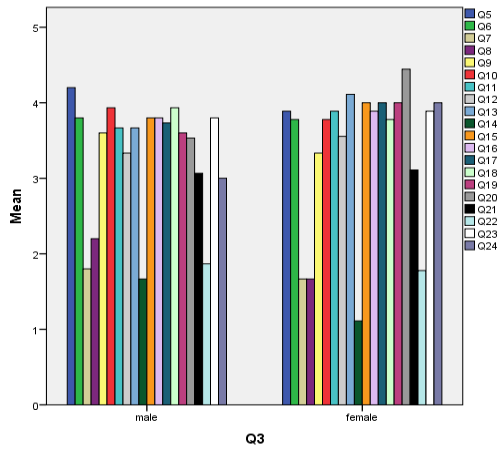


Fig. 9. The mean of each question according to gender.

B. Students' Suggestions

During the evaluation process, we also asked the students to give us their suggestions for the application's improvement. From the students who selected the option yes in question 25 one more question was opened, question 26, so as they could add their suggestions for improvement. Most of the suggestions we received were related to technical improvements. Some of the comments are listed below:

- Include levels with increased difficulty and time limits.
- Improve the user interface.
- Include a separate history of wrongly answered questions.

We also received several positive comments for the "WebTech" application such as:

- A very nice application.
- The application combines gaming with learning ideally.
- Why don't we play more in lessons?

V. DISCUSSION

The previous results raise interesting issues. Firstly, most of the students were at the age of 18. This age distribution is logical because the "Web Technologies" course is taught in the first semester and only a small number of students who fail in the exams attend the course again. Furthermore, there is no need to stress that all the students owned a mobile device and there no problems occurred during the application's installation. Additionally, the majority of the students had not used a similar mobile application before.

From the received answers in questions 5 to 9, we observe that most students believe that the application's content is fully relevant with the course's content (54.2% in the strongly agree option) and that the content includes theoretical and practical questions (a total of 79.2% in options agree and strongly agree). Furthermore, the majority of the students thinks that the application does not include logical or syntax errors (a total of 83.4% in the strongly disagree and disagree options) and also that the number of questions is not limited (a total of 76.6% in the strongly disagree and disagree options). Additionally, it is possible to

select a specific content category according to most students (a total of 54.1% in options agree and strongly agree).

The answers to questions 10 to 14 show us that the majority of the students agrees that the application uses a comprehensible language (37.5% equally in options agree and strongly agree) and that the amount of information provided in one screen is easy to manage (41.7% in option agree). Furthermore, half of the participants believe that the application is easy to navigate (50% in options agree and strongly agree) and that the interaction with the application is simple and easy (50% in option strongly agree). Moreover, 66.7% of the students strongly disagrees that the application is complex in its use.

The received answers in questions 15 to 18 show us that the majority of the students agrees that using the application's quizzes helps in the enhancement of their knowledge, and in the understanding and the assimilation through the appropriate feedback of the lesson's content in an easier way (37.5% equally in options agree and strongly agree). Furthermore, most students think that lessons should be supported by this type of applications (total of 75% in options agree and strongly agree).

From the received answers in questions 19 to 21 we observe that most of the students feel that they would use the application again in order to learn the lesson's content (37.5% and 29.2% in options agree and strongly agree). The students think that the application is attractive (37.5% and 33.3% in options agree and strongly agree) and a 29.2% of the students feels excited while playing with the application's quizzes.

For questions 23 and 24 the students think that the time needed for loading a new quiz game is satisfactory (a total of 75% in options agree and strongly agree), but the opinions vary when it comes to the number of available settings and options with some to believe that they are enough (25%) and some the opposite (29.2%).

For questions 22 and 25 the majority of the students (83.3%) answer that the application did not stop unexpectedly and more than half think that the application needs improvement (58.3%).

Moreover, there are some differences in opinions between male and female participants. More specifically, the female participants grade more positively the facts that the interaction with the Webtech app is simple and easy, that it has many available options and that playing with the app is attractive. On the other hand, the male participants think evaluate higher the fact that the number of questions included in the quizzes is limited and that the webtech app is complex.

VI. CONCLUSIONS AND FURTHER RESEARCH

The application's evaluation indicated an easy-to-use, stable and quite efficient application, which does not increase the user's cognitive load.

More specifically, as far as the application's content is concerned, it is relevant with the course Web Technologies, and it includes a variety and an efficient number of theoretical and practical questions, with no logical or syntax errors, which are separated to categories. Furthermore WebTech is easy and comprehensible with the right amount of information to be included in each screen.

Additionally, the application provides an interesting and easy way of learning that could be used in other lessons as well, for it is an attractive application that the students might choose to use again for learning purposes. Moreover, the application has a good technical response with some improvements needed.

Moreover, the innovations of this study include the following points:

- The use of mobile devices in educational settings, during or outside the lesson.
- The exploitation of the devices that the students own and know how to use, so there is no need for extra training time.
- The use of games to learn a lesson's content.
- The support of the "Web Technologies" course.
- The promotion of an alternate way of teaching in universities.

Since nowadays students are extremely familiar with the use of smartphones, by being owners of at least one mobile device, the restructuring and improvement of an educational application based on the users suggestions and experiences can provide a strong and creative pedagogical tool and also more flexible and interesting ways of learning. Moreover, the use of cutting edge technologies can provide a well-structured and stable application, which can be easily expanded in many different ways. We are currently working on redesigning the application by taking the students' suggestions under consideration and on improving the technical features of the application using more agile technology, like for example providing some form of cloud support.

We intend to complete the application's translation in other languages and expand it technically in order to support other courses as well.

After the re-design of the application, a second testing process that will address a bigger sample of participants will follow, including the evaluation of its second version by the students during the course's lectures using descriptive and inferential statistic methods to provide more conclusive results. Through this evaluation, we expect to find out if the new version of this mobile application will attract even more the students' interest and whether it will actually enhance their learning.

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