

## *Full Length Research Paper*

# **The impacts of paper, web and mobile based assessment on students' achievement and perceptions**

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Accepted 6 August, 2009

**The aim of this study was to determine the impacts of paper based, web based and mobile based assessment on the achievement of the students in the internet assisted instruction. A further investigation was also performed to find out perceptions of the students on the delivery mode of the assessment. 2\*3 factorial design was used in the study. Thirty eight students who formed experimental and control group, attended the study for 3 weeks. The findings of the study revealed that there was no significant difference between the achievement level of the students who took paper, web and mobile based assessment and the students who took only paper based test. However, a significant difference was found between the scores of the test taken in the second week and those of the others. Finally, it was found that students had positive perceptions on web and mobile based test due to the ease of use, comprehensive and instant feedback. Besides, the most favored test was web based test and the least favored test was paper based test.**

**Key words:** Paper based test, web based test, mobile based test, achievement, perceptions, internet assisted instruction.

## **INTRODUCTION**

Universities have implemented numerous attempts and efforts to integrate information and communication technologies (ICT) into administration and instruction process in order to be an integral part of information and technology based society. Therefore, computer, internet and mobile technologies have been used for many purposes such as tracking and recording student information, administration of personnel and accounting, and delivering course contents, announcements and assignments. Web sites of courses have become widespread and the instructors have broadcasted their course syllabus, course contents and materials, course assignments, announcements and assessments via internet. Web sites of the courses have been used as an information portal which can support class teaching. As stated by Wellington et al. (2005), using internet in universities offer various opportunities such as decreasing cost in delivery of instruction, expanding the geographical scope of the university and offering education for a higher number of students. Internet assisted delivery of the courses allows students to have quick access to the information, the instructors and their friends. Internet assisted

learning provides some benefits to the instructors such as enriching her/his courses with a variety of materials and technologies, using different types of activities, monitoring learning process of the students, managing the assessment more easily and integrating innovation to his/her professional development.

Traditional assessment modes in crowded classrooms can be a serious load on the instructors (Mercier et al., 2004; Kim, 2005). Considering roles of the instructors in digital age, use of internet and even wireless technologies in the assessment can be very useful starting point for the instructors in order to be successful in integrating new technologies to the courses. Moreover, this integration process will support their professional career development.

Rouet et al. (2009) conducted a study to investigate the impact of web based and paper based delivery of quizzes on students' performance and perceived satisfaction. They found that students who studied with printed documents and undertook paper based quiz were superior to the students who studied with web documents and took web based quiz. Although the students expressed prefe-

rence on the paper materials and paper based quiz they appreciated the availability of the course web site. As authors suggested while integrating web technologies into assessment phase of the instruction, ease of use and legibility of the tests should be taken into considerations. Besides accessibility of the online content and test of the courses are important factor to support students anytime, anywhere access to the instruction.

In recent years, most universities recognized the educational excellence of the wireless campus. This is a great opportunity for the students to access information more easily at any area of the campus using their laptops. In addition, with the promotion of Palm, Pocket PC and Mobile Phones as learning media, the number of practices which deals with integrating such devices into instruction has increased in the universities. Thus, the students can reach the course scores, discussion forums, information systems and tests by using mobile phones and PDA devices whenever and wherever they want.

Seppälä and Alamäki (2003) conducted a study on comparing the effectiveness of face-to-face, internet and mobile based instruction. As a result of their study, they suggested that innovative internet and mobile solutions can be useful for academic teaching because of providing possibilities for open teaching.

Use of WAP or SMS based tests through PDA, PALM, mobile phone or computer in higher education has been promoted due to the fact that they support the learning process of the students, offer exercise media and provide the opportunity to test the expected learning level achieved (Dawabi, Wessner and Neuhold, 2003; Kennedy and Sugden, 2003; Evans and Taylor, 2004; Mercier, et al., 2004; Lim and Lim, 2006; Scornavacca and Marshall, 2007; Wentling, Parkz and Peiper, 2007). However, as stated by Homan and Wood (2003), the cost of such services for the students should be decreased so that these new learning media can be widely used. Homan and Wood (2003) analyzed the achievement level and views of the students on the paper based and mobile based tests in internet based wireless and traditional classrooms. They found that there was no significant difference between students' achievement level and the students had positive views about the wireless test conducted on PDA, however the students stated that they wanted to use the infrastructural opportunities of the university, instead of their own devices. Scheele et al. (2002) conducted a study in which they analyzed the performance of the students in a wireless test which was conducted with handheld computers and included different question types such as multiple-choice and fill-in, in the interactive lecture developed by the authors. They found that the students believed that this test type was useful and desirable, and that the students were more careful and attentive during use of such tools.

The results of the most researches in the literature have focused on the students' achievement level in web or

paper based tests and mobile or paper based tests. However, there is no comprehensive research on the students' achievement and perceptions in paper, web and mobile based tests. This study aims to determine the effects of paper based test, web based test and mobile based test on the achievement levels and perceptions of the students in an internet-assisted course in the university.

### Research questions

1. Is there any difference between the scores of the experimental group that undertook paper based test, web based test and mobile based test and the scores of the students of the control group who undertook only paper based test?
2. Is there any significant difference between the test scores received by the students in the tests undertaken in 3 weeks?
3. What do students think about different delivery mode of the tests?

### MATERIALS AND METHODS

This study was designed with 2\*3 factorial design methods. Dependent variable of the study was the scores obtained by the students from 3 tests in a period of 3 weeks. The students were divided into two groups, including experimental group and control group.

#### Participants

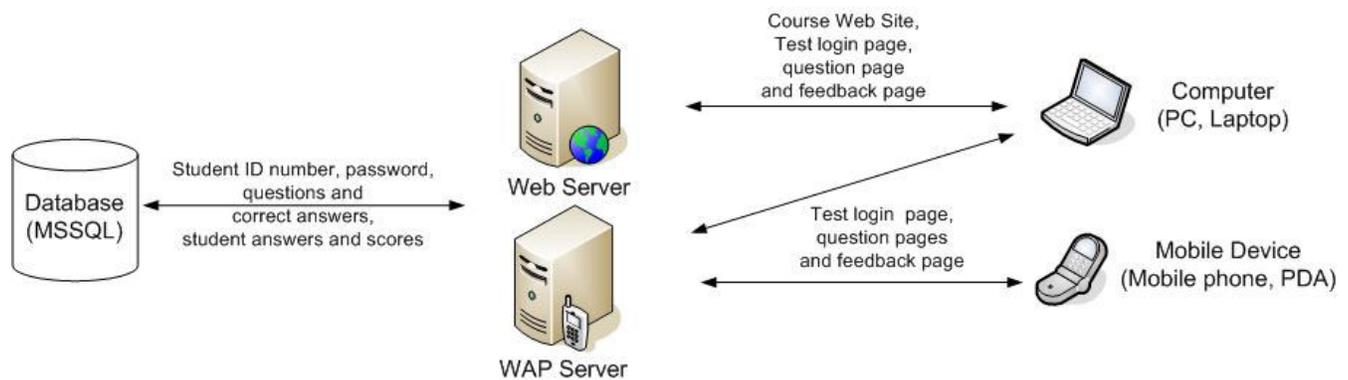
Thirty eight students who were in the 2nd class in the Department of Computer Education and Instructional Technologies and attending Computer Hardware and Microprocessors course in the Spring Semester of 2006- 2007 participated in the study. 20 students from section A formed experimental group and 18 students from section B formed control group. Experimental group undertook paper based test, web based test and mobile based test respectively for 3 weeks. Control group undertook only paper based test for 3 weeks. Each test consisted of 10 true-false questions and it was scored by 10 points.

#### Instruments

Figure 1 below displays the system architecture used in the study. Database was used to record the student ID numbers, passwords, test questions and their correct answers, answers given by the students for each question in the tests, and performance scores. The web site of the course, test question page and feedback page were broadcasted through web server. The test pages and the feedback page used in the mobile based test were broadcasted through Wap server. Students were able to access web based test using the computers in the laboratory or their laptops. They could access mobile based test via computers and their mobile phones.

#### Course web site

Web site of the course was developed in order to support face-to-



**Figure 1.** Architecture of web based test and mobile based test.

face instruction with internet technologies. Course syllabus, materials, announcements, information and scores of assessments and related web site links were available on the course web site. In addition, students could have uploaded their assignment to the web server through the assignment page. After that, the instructor delivered all assignment files via web site so students could find the opportunity to download and analyze the assignments of their friends. In addition, the students could upload and share the materials they used in the weekly technology follow-up seminars.

#### **Paper based test, Web based test and Mobile based test**

Each test was 10 point scored and made of 10 true-and-false questions. To assure that the tests were adequately designed to determine the real achievement levels of the students, they were validated by university instructors who have given lessons on Computer Hardware and then the tests were revised according to their feedbacks.

**Paper based test:** In the first week of the study, experimental group and control group were given paper based test. The scores of experimental and control groups were announced to the students one week later. The experimental group undertook web based test in the second week and mobile based test in the third week while the control group undertook only paper based test in the second and the third week of the study.

**Web based test:** The students in the experimental group undertook web based test in the second week. Web based test was developed using HTML, PHP and MSSQL database.

Students logged in web based test using their ID numbers and passwords. The question page was designed to display all questions on the same screen. Students answered the questions and click 'Save answers' button. The answers were recorded to the database and the system calculated the scores of the tests. The feedback page were designed to display questions, student answers, correct answers of the questions, number of correct and incorrect answers and scores (Figures 2a and b).

**Mobile based test:** The students in the experimental group undertook mobile based test in the third week of the experiment. Mobile based test was developed using WML, PHP and MSSQL database. Students logged in mobile based test using their ID numbers and passwords through Computer/Laptop or mobile phones. Every question was displayed in different page considering the screen sizes of the mobile phones. Students had right to go back to the

previous questions and change their answers before finishing the test. The answers of the students were calculated and recorded to the database. The feedback page was designed to present the number of the correct and incorrect answers and students' scores which was displayed in the end of the test. However this screen did not present which answers were correct or incorrect due to the limitations, such as the speed of WAP and size of the mobile screen. Figures 3a displays a WAP page which includes one question and Figure 3b displays feedback page of the mobile based test.

**Survey:** The perceptions of the students in the experimental group who undertook paper based test, web based test and mobile based test were gathered with the survey. The survey was validated by experts and revised. The survey consisted of 13 questions, 11 of which was 5-point Likert type questions (1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree and 5 = Strongly Agree) and 2 of which were open ended. These open ended questions were designed to ask students to explain which test they liked most and which test they liked least.

#### **Procedure**

The study conducted on the students from 2 classrooms for 3 weeks. All tests included true-and-false questions. In the first week, paper based test was applied to both groups. The scores of paper based test were announced to the students one week later. In the second week, web based test was given to the experimental group, while paper based test was given to the control group. 10 questions were broadcasted together on one screen in web based test. The feedback was given on the next screen to inform students about their answers for each question, the correct answer of the questions and the number of correct and incorrect answers and their scores.

In the third week of the study, control group was informed on the scores they received from paper based test which they took in previous week and they were given paper based test in the third week. The students in the experimental group were given mobile based test which was formed of 10 true-and-false questions. The questions in the mobile based test were displayed sequentially. Before the mobile based test ended, they had the opportunity to go back to the previous questions and change their answers. Feedback page which was displayed at the end of mobile based test informed the students about number of correct and incorrect answers and their scores. The students entered the web based test and mobile based test with their student ID numbers and passwords and they had right to use these systems only once. Each of

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### BTO 210 QUIZ 2 (Şube 1) - EQUİZ

Aşağıdaki cümlelerin doğru veya yanlış olmalarına göre cümlelerin sağ tarafındaki D/Y seçeneklerini işaretleyiniz	Doğru	Yanlış
Depolama birimleri kapasitelerine göre <b>en büyükten en küçüğe</b> doğru şu şekilde sıralanır: HDD-RAM-L2-L1	<input type="radio"/> D	<input type="radio"/> Y
ASUS M2NPVMX 6150 DDR2 VGA+GLAN+SATA2 16X anakart modelinde Ekran kartı onboard'dur.	<input type="radio"/> D	<input type="radio"/> Y
Gerçek-zaman saati olarak çalışan ve BIOS'a sistem saatini bildiren donanım elemanına CNR denir.	<input type="radio"/> D	<input type="radio"/> Y
İşlemci ile bellek arasındaki veri yoluna FSB denir.	<input type="radio"/> D	<input type="radio"/> Y
Slotların sahip oldukları bant genişlikleri <b>en azdan en fazlaya</b> doğru şu şekilde sıralanır: ISA – EISA – AGP8x - PCI - PCIx16	<input type="radio"/> D	<input type="radio"/> Y
8 bit veri aktarımı yapan ve 25 uçlu konektörü olan port COM2'dir.	<input type="radio"/> D	<input type="radio"/> Y
2 adet ASUS - EN6600 256 MB GE-FORCE 6600 ekran kartını birlikte kullanmak istiyorsak anakartımızda SLI özelliğinin olması gerekir.	<input type="radio"/> D	<input type="radio"/> Y
2 HDD'ye bir HDD gibi veri yazmak ve erişmek için kullanılan teknolojiye "Primary & Secondary Master" denir.	<input type="radio"/> D	<input type="radio"/> Y
Portlar hızlarına göre <b>en hızlıdan en yavaş</b> a doğru şu şekilde sıralanır: USB2.0-Firewire- LPT1-COM1-	<input type="radio"/> D	<input type="radio"/> Y
Intel Core 2 Quad işlemcimizin HT özelliği varsa mantıksal/sanal olarak 8 işlemcimiz vardır.	<input type="radio"/> D	<input type="radio"/> Y

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tarafından 0.0294 saniyede cevaplandı.

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Figure 2a. Web based test question page.

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### BTO 210 QUIZ 2 (Şube 1) - EQUİZ

Aşağıdaki cümlelerin doğru veya yanlış olmalarına göre cümlelerin sağ tarafındaki D/Y seçeneklerini işaretleyiniz	Cevabınız	Doğru Cevap
Depolama birimleri kapasitelerine göre <b>en büyükten en küçüğe</b> doğru şu şekilde sıralanır: HDD-RAM-L2-L1	D	D
ASUS M2NPVMX 6150 DDR2 VGA+GLAN+SATA2 16X anakart modelinde Ekran kartı onboard'dur.	D	D
Gerçek-zaman saati olarak çalışan ve BIOS'a sistem saatini bildiren donanım elemanına CNR denir.	D	Y
İşlemci ile bellek arasındaki veri yoluna FSB denir.	Y	D
Slotların sahip oldukları bant genişlikleri <b>en azdan en fazlaya</b> doğru şu şekilde sıralanır: ISA – EISA – AGP8x - PCI - PCIx16	Y	Y
8 bit veri aktarımı yapan ve 25 uçlu konektörü olan port COM2'dir.	Y	Y
2 adet ASUS - EN6600 256 MB GE-FORCE 6600 ekran kartını birlikte kullanmak istiyorsak anakartımızda SLI özelliğinin olması gerekir.	Y	D
2 HDD'ye bir HDD gibi veri yazmak ve erişmek için kullanılan teknolojiye "Primary & Secondary Master" denir.	D	Y
Portlar hızlarına göre <b>en hızlıdan en yavaş</b> a doğru şu şekilde sıralanır: USB2.0-Firewire- LPT1-COM1-	D	Y
Intel Core 2 Quad işlemcimizin HT özelliği varsa mantıksal/sanal olarak 8 işlemcimiz vardır.	D	D

**Quiz Sonuçları: Doğru Sayısı=5 , Yanlış Sayısı=5 , Boş Sayısı=0  
Aldığınız Puan=5**

Quiz Bitmiştir....

tarafından 0.0008 saniyede cevaplandı.

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Figure 2b. Web based test feedback page.



Figure 3a. Question page of mobile based test.



Figure 3b. Feedback page of mobile based test.

the tests had 10 true-and-false questions, the numbers of correct answers were calculated as the achievement score and there was no time limitation.

## RESULTS

### Achievement in paper based, web based and mobile based tests

Two-factor ANOVA was applied for repeated measurements to find out whether there is significant difference between the scores of the students. Table 1 summarizes the ANOVA results.

No significant difference was found between the achievement of the students in the experimental group and those of the control group [ $F(1-36) = .491, p > 0.05$ ]. Besides, being in different groups and undertaking different delivery mode of tests did not have common effect on the scores of the students [ $F(2 - 67) = 2.393, p > 0.05$ ]. However, there was significant difference between the scores of the tests in three weeks. [ $F(2 - 67) = 12.381, p < 0.05$ ]. Mean scores of the tests were as

follows; paper based test ( $\bar{X} = 7.45$ ), mobile based test ( $\bar{X} = 7.70$ ) and web based test ( $\bar{X} = 6.80$ ). As seen from this finding, mean score of the web based test in the second week were lower than those obtained in other weeks. This finding shows that the test of the second week was more difficult than others.

### Students' perceptions on paper based, web based and mobile based test

The survey ( $N = 20$ ) was conducted by the students who were in the experimental group in order to obtain their perceptions on different tests. Table 2 summarizes the means and standard deviations of the answers.

Means of the items which related to paper based test in Table 2 are lower than 2.00, it shows that students did not prefer paper based test due to the delayed and general feedback of the test. The item means of the mobile based test is between 3.00- 4.00, it means the students liked and preferred mobile based test due to its'

**Table 1.** Results of the Two Way ANOVA for Repeated Measures of Students' Scores in Paper based test, Web based test and Mobile based test.

Source of variation	Sum of Square	df	Mean Square	F	p
Between Groups	142.289	37			
Group (Experiment/Control)	.491	1	.491	.125	.726
Error	141.798	36	3.939		
Within Groups	168.928	76.409			
Paper based test/Web based test/Mobile based test	41.191	1.853	22.231	12.381	.000
Group* Paper based test/Web based test/Mobile based test	7.963	1.853	4.298	2.393	.103
Error	119.774	66.703	1.796		
Total	311.217	113.409			

**Table 2.** Students' Perceptions on Paper based, Web based and Mobile based test.

Items	$\bar{X}$	S
1. I prefer paper based test.	1.85	0.99
2. I liked the web based test.	4.65	0.59
3. I liked mobile based test.	3.30	1.42
4. Use of different media, such as internet and WAP increased my attention to the course.	4.45	0.60
5. If I am to undertake test in other courses, I would prefer web based test.	4.30	0.80
6. If I am to undertake test in other courses, I would prefer mobile based test	3.15	1.31
7. It was easy to use mobile based test.	3.70	1.30
8. It was easy to use web based test.	4.70	0.57
9. Paper based test was the best in offering feedback on my answers to the questions and my scores.	1.90	1.12
10. Web based test was the best in offering feedback on my answers to the questions and my scores.	4.25	1.12
11. Mobile based test was the best in offering feedback on my answers to the questions and my scores.	3.50	1.19

instant feedback. However, means of the items which related to web based test are above 4.00, it means that students strongly liked and preferred web based test due to the ease of use and detailed and instant feedback of the test. In addition, the students stated that use of media such as internet and WAP increased their attention ( $\bar{X}=4.45$ ) to the courses. The preferences of the students in respect to the delivery mode of tests can be seen from Table 3.

Sixty percent of the students (n = 12) reported that the delivery mode of test they liked most is web based test, due to various reasons, including: ease of use, appearance of all questions on the screen at the same time, the opportunity to see the correct and incorrect answers quickly, in other words the opportunity of receiving detailed and instant feedback. Some of the responses of the students are as follows:

“We are able to see all the questions, answer them easily and can see our correct and incorrect answers. We get the results instantly”

**Table 3.** Most and least liked test by the students.

State	Paper based test		Web based test		Mobile based test	
	f	%	f	%	f	%
Most liked	-	-	12	60	8	40
Least liked	15	75	-	-	5	25

“I believe use of web based test is easier than the mobile based test”

Eight (40%) students who said they liked mobile based test most listed the reasons as follows: it is different; it can be accessed from everywhere; it offers feedback on the results instantly. The students who said they liked the mobile based test most expressed the following opinions:

“The best think about mobile based test is that questions come one after another.”

"Mobile based test is different, it is an alternative choice and it increases the attention to the course."

"As we saw the answers instantly in the web based test, we did not feel the need to search for it"

Seventy five percent of the students (n = 15) reported that the test they liked least is paper based test and they listed the following reasons for it: it is classic and boring; it increases the excitement, the feedback comes late:

"Paper based test is a too classical method."

"There is no feedback in the paper based test. I need to wait to see my score for a week."

"Paper based test remains to be more primitive, in comparison to the other ones."

Twenty five percent of the students (n = 5) stated that the test they liked least is mobile based test and listed the following reasons for it: absence of a detailed feedback, difficulty of its use and WAP fees. Some students expressed their opinions as follows:

"The feedback is insufficient in mobile based test."

"As it felt like different, I was concerned about making a mistake."

## DISCUSSION

When the instructors use information and communication technologies in their courses, they are able to broadcast the materials, syllabus, announcements and assignments of the courses, and they are able to interact with their students easily out of the lecture hours. They are further able to make their courses richer and more attractive with various activities and materials. The instructors who only use paper based assessments, need to print, duplicate and group papers, and after the implementation they have to grade and record students' scores according to the classroom list and finally announce the scores to the students. These processes constitute a heavy burden for the instructors teaching in crowded classrooms. This is why use of ICT in assessment and evaluation process of the courses has become more and more common.

This study investigated achievement levels of the students in different tests and the perceptions of the students on these tests in an internet assisted course. The experimental group was given paper based, web based and mobile based test, while control group was given only paper based tests for a period of 3 weeks. The scores of the students were announced in the following week of the courses for the paper based tests. In web based test, all of the questions were given on the screen and in the next screen comprehensive feedback was displayed including the questions, correct answers of the questions, students' answers, number of correct and incorrect answers and their scores. In mobile based test, each question was

given on the separate screen, due to the limited screen size of the mobile phones, and feedback was given including the number of correct and incorrect answers and their scores. It was observed that these feedback types were very important for the students. When asked about these different feedback types, the students stated that comprehensive and instant feedback offered by the web based test was more useful than the general and late feedback in the paper based test and the limited feedback in the mobile based test. Furthermore, the students reported that they liked web based and mobile based test because of these reasons; these two test types increased their attention to the course, they were easy to use and paper based test was primitive and classic compared to others. The students' positive perceptions about mobile based test were similar with the studies conducted by Homan and Wood (2003) and Scheele et al. (2002). It is assumed that mobile technology has great potential to empower everytime and everywhere learning for students of mobile generation.

No significant difference was found between the achievements of students although they undertook different delivery modes of the tests. This result indicates that different technologies can be used in the assessment and evaluation processes of the courses. Although undertaking paper based, web based or mobile based test did not affect the achievement of the students, it could affect their attention and motivation to the course. The instructors can decrease time loss caused by the traditional assessment methods, if they use technologies such as internet and WAP. Undoubtedly, instructors needs in-service training or personal effort and extra time in order to gain knowledge and skills required to learn, adapt and use these technologies. Continuous learning centers, information technology centers or instructional material development centers will be useful in order to ensure that instructors can use innovative practices without facing so many barriers. Rogers (1995) stated in the "Diffusion of innovation model" that instructors must have knowledge about the innovation, they must be convinced of the value and benefit of the innovation, they must decide to make use of the innovation and then they must evaluate the findings of the ICT application, and after that they must confirm the innovation to integrate ICT successfully into the course. Absolutely, instructors might face with many barriers through these processes. For example, if an instructor wants to use forum, bulletin board or Web 2.0 technologies in his/her course; he/she needs to learn about these new technologies, he/she needs extra time to develop innovative ways to integrate this technology into the course, and he/she should evaluate its' effectiveness. Through the adaptation, the instructor will cope with many barriers such as shortage in technical infrastructure of the university, shortage in getting required technical and motivational support and also the lack of education and time.

In conclusion, the instructors should be supported when coping with the challenges in integrating ICT into their teaching-learning process. This ICT integration period represents both the changing roles of the instructors in digital age and the importance of the development of corporate platforms in the universities. It will be beneficial to begin with the basic steps such as delivering course materials, assignments and assessments through web or mobile platforms in the integration of emerging technology into teaching. This study shows evidence that using different technologies in assessment process of a course would not negatively affect the students' achievement whereas this approach would increase students' motivation and attraction for the course. However, the number of participants in this study was thirty eight, future studies are suggested to be conducted which involve more participants to investigate how different types of questions (such as multiple choice, game-based, etc.) and different assessment methods (such as summative, formative, or performance assessment) can affect student achievement and perceptions.

## ACKNOWLEDGMENT

The author wishes to thank Mustafa Kemal Oran for his help in programming the web and mobile codes.

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