

Comparison of Students Performance in Cell Phone-based, Computer-Based and Paper-Based Testing

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Abstract: The purpose of this study is to determine whether the use of Cell Phone-based, Computer-Based assessment strategies are effective in evaluating students' achievement in educational technologies compared to the paper-based assessment strategy used in Jordanian Universities.

The researcher followed the equivalent pre/post-test two-group design. To achieve the aim of the study, a pre/post-test assessment was constructed to measure students' achievement in educational technologies. The test consisted of 20 right or wrong questions selected from the curriculum of the course (Appendix 1).

The subjects of the study consisted of 192 students distributed on three sections, which were selected purposefully enrolling in Jadara University during the second semester of the academic year 2008/2009.

The participants were (59) male students for the experimental group and (34) male students for the control group, while the female students for the experimental and control group were (63) and (36) respectively. Those participants were distributed among three purposefully selected sections in Jadara University.

Descriptive statistical methods were used (means and standard deviation) for pre and post-tests of students' achievement in Educational Technologies to experimental and control groups. Comparison statistical methods were used (Two Way ANOVA) analysis of variance to make a comparison between the control and the experimental group, gender variable (male and female), and interaction between them.

The findings of the study indicated that there were statistically significant differences in the post- test between the control group and the experimental group in favor of the experimental group, and there was a statistically significant difference in the students' achievement due to gender in favor of females. There was statistically significant difference due to the interaction between gender and group in favor of female students in the experimental group.

The researcher proposed some recommendations to enhance the effect of using cell phone-based and computer-based assessment on students' achievement such as conducting further researches on other populations and for a longer time.

Keywords: assessments, cell phone, tests

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مقارنة بين أداء الطلبة في التقويم المعتمد على استخدام الهاتف الخليوي، التقويم المعتمد على استخدام الكمبيوتر، والتقويم المعتمد على استخدام الورقة والقلم

ملخص: هدفت هذه الدراسة الى بيان أثر التقويم المعتمد على استخدام الهاتف الخليوي والتقويم المعتمد على استخدام الكمبيوتر على تحصيل الطلبة في مادة تكنولوجيا التعليم مقارنة مع التقويم المعتمد على استخدام الورقة والقلم في الجامعات الأردنية. وقد استخدمت الباحثة تصميم الاختبار القبلي/ البعدي للمجموعات المتكافئة. ولتحقيق هدف الدراسة تم بناء اختبار قبلي/ بعدي لقياس تحصيل الطلبة في تكنولوجيا التعليم. وقد تكون الاختبار من 20 فقرة صح ام خطأ تم اختيارها من منهاج مساق تكنولوجيا التعليم (ملحق 1).

تكونت عينة الدراسة من (192) طالب تم اختيارهم قصديا، وتم توزيع الطلبة على ثلاث مجموعات أيضا تم اختيارها قصديا من الطلبة المسجلين في جامعة جدارا في الفصل الثاني للسنة الدراسية 2009/2008. تكونت المجموعة التجريبية من 59 طالب للذكور و63 طالبة للإناث، بينما تكونت المجموعة الضابطة من 34 طالب للذكور و36 طالبة للإناث موزعين على ثلاثة شعب قصدية الاختيار.

تم حساب المتوسطات الحسابية والانحراف المعياري للمجموعات الضابطة والتجريبية واجريت مقارنات بعدية باستخدام تحليل التباين الثنائي (Two Way ANOVA) للمقارنة بين المجموعات الضابطة والتجريبية، متغير الجنس والتفاعل بينهما.

أشارت نتائج الدراسة الى وجود فروق ذات دلالة احصائية بين المجموعة الضابطة والمجموعة التجريبية لصالح المجموعة التجريبية، كما أظهرت نتائج الدراسة وجود فروق ذات دلالة احصائية في تحصيل الطلاب الذكور والاناث ولصالح الاناث، بالإضافة الى وجود فروق دالة احصائية تعزى للتفاعل بين متغيري طريقة التقويم والجنس ولصالح الاناث من المجموعة التجريبية. وفي ضوء النتائج التي توصلت اليها الدراسة، توصي الباحثة باستخدام التقويم المعتمد على استخدام الهاتف الخليوي والتقويم المعتمد على استخدام الكمبيوتر لما له من تأثير على مستوى الدقة اللغوية عند الطلبة، كما أوصت باجراء دراسات أخرى على مجتمعات دراسة أخرى ولفترة أطول.

Theoretical background

Introduction

Assessment is central to teaching and learning. The assessment information is needed to make informed decisions regarding students' learning abilities, their placement in appropriate levels and their achievement.

According to Sadler (2005), assessment refers to the making of evaluation on students' overall performance and generating assumptions regarding their learning and production education-wise, which include the quality or achievement in tasks such as tests, projects, reports and examinations. In the other hand, the success of any assessment is depending on the effective selection and use of appropriate procedures as well as on the proper

interpretation of students' performance. Thus, assessment procedures also help in evaluating the suitability and effectiveness of the curriculum, the teaching methodology and the instructional materials. Van der Watering *et al.* (2008) note that students considered the traditional assessment to be primarily a measurement consisting of comprehension and application-based questions that required the drawing of conclusions, problem solving, analysis, interpretation and critical thinking. The correlations between students' preferences and assessment perceptions in their findings were not significant due to the existence of a distinction between students' preferences and their perceptions.

In the integral process of learning and instruction, only high quality assessment can facilitate high-quality learning. Mueller (2005) observes that while researchers in higher education have proposed a series of changes such as alternative assessment to replace traditional assessment, these proposals have yet to be implemented in many institutions.

In recent years educators have utilized various types of assessment to better understand and document students' learning and progress. Yet, the similarities and subtle differences among some of the assessment methods have not been fully explored. Since the early 1960s a strong reliance on traditional test scores has, to an extent, affected both; the teachers' control of the curricula and the obligation of teachers to judge students' progress in global terms for assessment. Large-scale traditional achievement testing is a costly and time-consuming technique to ensure accountability (Bauer, 1992; Madaus & Kellaghan, 1993).

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

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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.

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.

Significance of the study

The current study on the effect of Cell Phone-based, Computer-Based and Paper-Based assessment on students' achievement is expected to serve two goals: To help with integrating new ways of evaluation into educational technology courses to meet the new century demand, and to find solutions to some of the problems of using technology in Jordanian Universities.

The choice of the topic for this study is motivated by several factors: Firstly, the study responds to the increased demand in the use of technological assessment in education to meet the new educational needs. Secondly, the study may motivate other researchers to reconsider the methods of evaluation used nowadays. And finally, the Cell Phone-based, Computer-Based and Paper-Based assessment procedures might be a source of excitement and motivation to Jordanian students in their educational technology courses.

Statement of the problem

Over the years, mobile phone subscribers in Jordan have increased tremendously to a degree that nearly everyone in Jordan owns a mobile phone. It is timely to start accumulating first-hand knowledge of what mobile phone can offer in the area of assessment.

Surveying studies were written on the use of cell phone, computer and paper and pencil, the researcher found no studies on the impact of the three tools on assessment together. So this study aims to shed light on the most effective ways on their test assessment.

Purpose of the study

The purpose of this study is to determine whether the use of Cell Phone-based, Computer-Based assessment strategies are effective in evaluating students' achievement in educational technologies compared to the paper-based assessment strategy used in Jordanian Universities.

Questions of the study

This study attempts to answer the following questions:

- 1-Are there any statistically significant differences ($\alpha=0, 05$) between the groups due to assessment strategy (Cell Phone-based, Computer-Based and Paper-Based assessment)?
- 2-Are there any statistically significant differences ($\alpha=0, 05$) between the groups due to gender (male or female)?
- 3- Are there any statistically significant difference ($\alpha=0, 05$) in the interaction between groups and the gender?

Limitations of the study

This study is limited to the male and female second year students in Jadara University, and to any other similar samples. Besides, it is limited to the instrument, which was developed by the researcher for the sake of the study.

Literature review

Some researchers suggest that the benefits of mobile phones are not merely limited to increased access to educational services. Mobile Learning, they indicate, can also facilitate changes in the character of learning modalities that in turn impact educational outcomes. In this regard, mobile Learning represents more than a mere extension of traditional forms of education; mobile Learning facilitates alternative learning processes and instructional methods that the theories of new learning identify as effective for learning.

According to proponents of new learning, mobiles facilitate designs for personalized learning in that they are responsive to difference and diversity in the way learning occurs. They facilitate designs for situated learning by providing learning during the course of the activity – in the field for a botany student, in the classroom for a teacher trainee, or in the workshop for an engineer. In this sense, mobile Learning also facilitates designs for authentic learning, meaning learning that targets real-world problems and involves projects of relevance and interest to the learner (Kukulska- Hulme & Traxler 2007, pp. 184-86; Traxler, 2007, p. 7).

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The supposed value of mobiles also arises from the manner in which they facilitate lifelong learning. Mobiles can support the great amount of learning that occurs during the many activities of everyday life, learning that occurs spontaneously in impromptu settings outside of the classroom and outside of the usual environment of home and office. They enable learning that occurs across time and place as learners apply what they learn in one environment to developments in another (Sharples et al., 2005, pp. 2, 4; 2007, pp. 222-23).

Mobile phones theoretically make learner-centred learning possible by enabling students to customize the transfer of and access to information in order to build on their skills and knowledge and to meet their own educational goals (Sharples et al., 2007, p. 223). Mobile Learning thus exerts a democratizing effect on the learning experience as learners take a greater responsibility for the learning process instead of being passively fed information by an instructor. Whereas in traditional models of education the goal is the transfer of knowledge from teacher to student, mobile Learning empowers students to actively participate in the learning process to make it a process of construction and not mere instruction (dela Pena-Bandalaria, 2007).

Over the past decade, access to and use of computers in homes and schools have increased sharply. Both in and out of the classroom, students' educational use of computers has also increased, particularly for writing and research (Becker, 1999; Russell, O'Brien, Bebell, & O'Dwyer, 2002). Over this same time period, reliance on large-scale tests to compare the quality of education provided by nations has increased. For example, every four years, the Trends in International Mathematics and Science Study compares the performance of approximately 40 nations in mathematics and science. Similarly, the Progress in International Reading Literacy Study compares literacy achievement across 35 nations (Amrein & Berliner, 2002).

To contextualize learning, Chen *et al* (2003). Created a mobile system using PDAs and a mobile server to scaffold students' learning about bird watching. The system harnesses the strengths of mobile learning environment including interactivity to cater to individual needs and foster interaction between the expert and the learner for bird watching.

Based on their formative evaluation, students who used the system improved their learning compared to those assisted by traditional guidebook.

In their paper, Relan *et al* (2004). Examines the use of PDAs as an integral component of the clinical curriculum (clerkships) at a leading US based

medical school. PDAs are used by students to access pharmacopoeia and knowledge-based tools, and to capture data for patients. A survey of students revealed that pharmacopoeia and knowledgebased tools were considered useful by students as they addressed knowledge gaps and provided instant response to students' queries. On the use of patients' data logged by students, it was observed that while the technology was in place to gather data, most members of the clinical faculty were not using the data to scaffold student learning.

His study involves enhancing users' experience in a museum using nomadic web content delivered using a clamshell pocket computer (HP Jordana 548). The author noted that while mobile devices may introduce new activities and new ways of interactions in a museum, users also found the experience to be socially isolating.

In teacher training, Seppala *et al* (2003). Makes use of mobile devices (phones and digital cameras) to allow supervising teachers and trainee teachers to share and discuss teaching ideas. Short message service (SMS) and digital pictures could be uploaded to a central server accessible by all. The study noted considerable amount of exchanges amongst the participants, especially in digital pictures.

In the field of education, few comparative studies on test mode were carried out prior to 1986. However, an early 1985 study by Lee and Hopkins found the mean paper-and-pencil test score to be significantly higher than the mean computer-based test score in arithmetic reasoning. Results of this study highlight scratch workspace as a salient factor in arithmetic test performance.

In addition, Lee and Hopkins concluded that the inability to review and revise work affected performance, and argued that only "software that allows the conveniences of paper-and-pencil tests, e.g., the ability to change answers and the ability to review past items, be used in future applications" (p.9). Collectively, early research on cross-modal validity of arithmetic reasoning tests provided mixed results: computers were found to enhance (Johnson & Mihal, 1973), as well as impede (Lee, Moreno, & Sympton, 1986) test performance.

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 preference on the paper materials and paper based quiz they appreciated the

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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.

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.

Design and Methodology

The researcher discussed the procedures that she used to conduct the study. She described the study variables, population, sample, instrument, procedures and statistical analysis that were used in the study.

Variables of the study

-The independent variables:

- 1-The assessment strategies (Cell Phone-based, Computer-Based and Paper-Based assessment).
- 2- Gender; male and female
- 3- The dependent variable: The students' achievement.

Population of the study

The population of the study consisted of:

All the students of second year enrolling in Jadara University during the first semester of the academic year 2008/2009. They were 680 female students and 565 male students.

Participants of the study

The subjects of the study consisted of 192 students and distributed on three sections, which were selected purposefully. The first section was evaluated using cell phone-based assessment, the second section was evaluated using computer-based assessment, and the last section was evaluated using paper and pencil-based assessment. The last section was the control group; table (1) shows the distribution of the subjects of the study according to group and gender variables.

Table (1)
Distribution of the participants of the Study According to Group and Gender Variables

Group	Gender	N	Percentage
Cellular-based	Male	29	0.15
	Female	33	0.17
	Total	62	
Computer-based	Male	30	0.15,6
	Female	30	0.15,6
	Total	60	
Paper-based	Male	34	0.17,7
	Female	36	0.18,7
	Total	70	

Table (1) shows that the participants in the study were male and female students in the experimental and control groups.

Design of the study

This study was carried out to follow the equivalent pre /post-test two-group design. The experiment consisted of two levels: The participants of the experimental group were exposed to the cell phone-based assessment and computer-based assessment for (8) weeks. However, the subjects of the control group were exposed to the paper and pencil-based assessment for the same period. A pre-test was given before the application of the assessment techniques to all groups to make sure they are equivalent and the same test was administered as a post-test after applying the assessment techniques to see whether the techniques had any influence on the groups and which technique had more influence on the subjects than the other.

Instruments of the study

The researcher developed a test based on the instructional material of the educational technology course. The test was prepared by the researcher. She validated it and made it reliable.

All groups; the experimental groups as well the control group, were taught by the instructor of the course. The subjects in all groups underwent a pre-test to determine their actual level before starting the experiment, and the same test was administered as a post-test at the end of the experiment to assess subjects' achievement. The time interval between the pre-test and the post-test was (16) weeks; a period long enough to minimize the effect of the pre-test on the results and conclusions of the experiment; The test contained twenty right or wrong statements.

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Reliability of the instrument

To ensure the test reliability, the researcher followed test/retest technique. The researcher administered it to a pilot sample of (20) subjects out side the study sample in the same university from which the subjects were chosen with a two-week period between the pre-test and the post-test. The reliability of the test was concluded using correlation coefficient and found to be 0.87. The researcher considered this value acceptable for the purposes of the study.

Validity of the instrument

The researcher constructed the test instrument taking into consideration the instructional material. The researcher validated the instrument by consulting two educational technology professors teaching at Al-Albayt University, two instructors at Jadara University. The researcher followed the recommendations of the referees and made amendments accordingly. When producing the final version of the test, the remarks and recommendations of these technology experts were taken into account.

Instructional material

The instructional material is the second year course entitled "an Introduction to Education Technologies". At the end of the course students sat for a test to check their achievement

Procedures of the study

All participants in the study were enrolled in three sections designed to examine the effect of using Cell Phone-based, Computer-Based and Paper-based assessment in evaluating students' achievement in educational technologies .

Students in the three sections were given the same teacher created, criterion-referenced final examination. The results of this final exam were calculated to show the effect of applying these new strategies on the achievement of the students.

The researcher used Cell Phone-based assessment using Hot Lava Software with the first section, Computer-Based assessment with the second section, and paper-based assessment with the third section. A practice quiz was offered to students prior to the examination. Each of the three tests comprised 20 right or wrong questions selected from the curriculum of the course (Appendix 1). All the students received the same test questions. The questions related to course content that was already covered by instructor in the classroom, and the students were informed that tests counted for course grades. The grading policy was also clearly stated in the course syllabi.

Equivalent test

Means, standard deviation and (Two-Way ANOVA) analysis of variance were used to analyze data on the pre-test. In order to determine the equivalency of the two groups on pre-test, the means and the standard deviation were computed, as shown in table (2).

Table (2)
Means and Standard Deviation of Students' Scores on the Pre-test.

GROUP	SEX	Mean	Std. Deviation	N
Cellular-based	Male	57.76	5.914	29
	Female	56.82	6.473	33
	Total	57.26	6.185	62
Computer-based	Male	58.00	6.242	30
	Female	54.83	9.868	30
	Total	56.42	8.341	60
Paper-based	Male	55.44	10.827	34
	Female	57.08	9.955	36
	Total	56.29	10.345	70
Total	Male	56.99	8.147	93
	Female	56.31	8.881	99
	Total	56.64	8.518	192

Table (2) shows that the mean scores and standard deviation of pre-test both by group and by gender were close to each other.

In order to find out if there are statistically significant differences between the two groups before treatment, Two-Way ANOVA analysis of variance was performed. The results are reported in table (3).

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Table (3)
Results of ANOVA Analysis of Students' Scores on the Pre-test.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
GROUP	38.930	2	19.465	.266	.767
SEX	32.209	1	32.209	.440	.508
GROUP * SEX	188.079	2	94.040	1.285	.279
Error	13611.518	186	73.180		
Corrected Total	13858.203	191			

The results of this analysis indicated that there were no statistically significant differences in the pre-test scores between the experimental and control groups. There was statistically significant difference in students' scores due to their gender. This indicates that the experimental and the control groups were almost equivalent before treatment.

Data analysis

To answer the three questions of the study, descriptive methods (means and standard deviation) were used on pre and post tests of students' achievement of the experimental and control groups. Comparison statistical method (Two-Way ANOVA) analysis of variance was used to make a comparison between the control and the experimental groups, gender variable (male and female), and interaction between the

Findings of the study

The purpose of this study is to investigate the effect of using Cell Phone-based, Computer-Based and Paper-Based assessment in evaluating students' achievement in educational technologies

The researcher followed the equivalent pre /post test two group designs. Therefore, the means, standard deviations and Two-Way ANOVA analysis of variance were used to analyze data. The results will be displayed based on the questions of the research.

Results Related to the First question

The first question: Are there any statistically significant differences ($\alpha=0,05$) between the groups due to assessment strategy (Cell Phone-based, Computer-Based and Paper-Based assessment)?

The statistical analysis was used to calculate the means and standard deviations for post data of language accuracy within two groups, control and experimental, as shown in table (4).

Table (4)
Means and Standard Deviation of Students' Scores on the Post-Test.

GROUP	SEX	Mean	Std. Deviation	N
Cellular-based	Male	86.55	5.992	29
	Female	87.42	6.139	33
	Total	87.02	6.037	62
Computer-based	Male	77.70	7.840	30
	Female	80.67	7.626	30
	Total	79.18	7.812	60
Paper-based	Male	73.38	8.139	34
	Female	76.81	6.985	36
	Total	75.14	7.707	70
Total	Male	78.88	9.178	93
	Female	81.52	8.190	99
	Total	80.24	8.759	192

It is obvious that the Cellular-based group got a higher mean score than the Computer-based and Paper-based groups, the Computer-based is higher than the Paper-based group; this indicates that Cellular-based assessment strategy and computer-based assessment strategy have strong impact on the experimental group.

To find out if there were statistically significant differences between the three groups' scores on the post-test, (Two Way ANOVA) analysis was performed, as presented in table (5).

Table (5)
Results of (ANOVA) Analysis of the Students' Scores of the three Groups on the Post Test.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
GROUP	4730.407	2	2365.203	45.951	.000
SEX	279.589	1	279.589	5.432	.021
GROUP * SEX	58.972	2	29.486	.573	.565
Error	9573.868	186	51.472		
Corrected Total	14654.979	191			

Table (5) shows that there were statistically significant differences in the post- test between the cell phone-based group, computer-based group and the paper-based group in favor of the cell phone-based group.

This means that the intervention of Cell Phone-based, Computer-Based assessment strategy affected students' achievement in educational technologies.

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Question two: Are there any statistically significant differences ($\alpha=0, 05$) between the groups due to gender (male or female)?

As shown in table (5), the results showed that there was a statistically significant difference in the students' achievement due to their gender in favor of female.

Results related to the second question

Question two: Are there any statistically significant differences ($\alpha=0, 05$) between the groups due to gender (male or female)?

As shown in table (5), the results showed that there was a statistically significant difference in the students' achievement due to their gender in favor of female.

Question three: Are there any statistically significant difference ($\alpha=0, 05$) in the interaction between groups and the gender (male or female)?

As shown in table (5), the results also showed that there was a statistically significant difference ($\alpha=0, 05$) due to the interaction between gender and group.

Post-Hoc Tests (Scheffe) was applied for comparisons between sub groups, tables (6, 7) show that.

Table (6)
Post-Hoc Tests (Scheffe) Result for Comparisons Between Sub Groups
Scheffe

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.
Cellular-based	Computer-based	7.83(*)	1.299	.000
	Paper-based	11.87(*)	1.251	.000
Computer-based	Cellular-based	-7.83(*)	1.299	.000
	Paper-based	4.04(*)	1.262	.007
Paper-based	Cellular-based	-11.87(*)	1.251	.000
	Computer-based	-4.04(*)	1.262	.007

Based on observed means.

* The mean difference is significant at the .05 level.

There are statistically significant differences among the cellular-based assessment Strategy on one side and the Computer-based assessment Strategy, the paper-based assessment Strategy on the other side in favor of the cellular-based assessment Strategy.

- The Computer-based assessment Strategy and the paper- based assessment Strategy in favor of the Computer-based assessment Strategy.

DISCUSSION

The study revealed that students gained better scores in cell phone-based test than in computer-based test in the course of Introduction to Educational Technologies. However, students scored the least in paper-based test.

The study also revealed a correlation between a student's gender and the student's test performance. Thus, instructors may include cell phone tests in their traditional in class courses or even using the cell phone as a means of teaching and testing courses to reap the benefits of cell phone testing, which include instant grading and feedback to the students.

When instructors test students via cell phone, they free up class time that would have been spent in administering tests. The students and instructors may spend this additional time on new or more advanced subject matters.

The limitations of this study include cell phone-based test conditions that I manipulated to make similar to the in-class test conditions. The cell phone-based tests were taken in a classroom and proctored by the instructor. The researcher used this condition to ensure that there were no incidents of cheating in the cell phone test. All students started at the same time. The condition, in fact, is different from normal of cell phone-testing conditions in which testing is allowed to take the test at any time or place. Future researches may try to determine there is a difference in student performance in proctored versus unproctored cell phone-based tests.

A future extension of this work may include assigning all the tests—cell phone, computer and paper-based—to two random groups of students and comparing the cell phone-based test performance in its natural conditions with the computer and in-class performance of the students for the same test.

Future researches may explain why the paper based test assessment consistently had test scores that were significantly lower than the other two methods of assessment. In addition, the results showed that gender was not correlated to the results.

Further studies are necessary to determine whether these results are applicable to other subjects of teaching or not.

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Comparison of Students Performance in Cell Phone-based

Appendix A The Instrument of Study

The Instrument of the Study

Click the choice that suits your answer.			
No	Question	Right	Wrong
1	Educational tools are element of the educational system.		
2	Educational technologies are style of work and a developed thinking.		
3	Technology of information is a part of educational tools.		
4	Simulation programs are educational computer programs.		
5	Practicing and training programs do give new information to the learner		
6	Word processing programs are used successfully with students of basic level.		
7	The term globalism in the technology of multimedia is		
8	Technology of multimedia do allow individualizing the educational situations.		
9	E-learning is a form of distance learning.		
10	Virtual classes on the internet is a means of giving lectures.		
11	Virtual classes include sophisticated techniques, like "transferring files".		
12	Virtual classes characterized by it higher cost over traditional classes.		
13	Digital library is an institution that offers informational resources.		
14	Integrity is a characteristic of multimedia.		
15	Variety in multimedia is giving opportunity to the learner to open to all resources world wide.		
16	Interactivity in multimedia means individualizing educational situations.		
17	Multimedia helps educational multimedia on enrolling all the learner's senses.		
18	Educational aids increases falling in verballity.		
19	Educational aids do not change behavior.		
20	Computer educational simulation is a real offering simulates reality.		