

Full Length Research Paper

Effectiveness of ICT approach on students' 8th grades achievement in mathematics

Ibrahim M. Arman

College of Education Science, Al-Quds University, Palestine. E-mail: iarman2001@yahoo.com.

Accepted 12 February, 2013

ICT is widely used in Schools, Universities and other organizations all over the world, either to support classroom learning or on its own. The Palestine schools and Universities are no exception. Usually, a special kind of web-based content management system is used for running ICT contents and courses. These systems hold all the content and information of the students and also provide the interactive tools to support learning process. While using such systems makes the ICT experience much easier, it also induces some problems like the heterogeneous previous knowledge of the students. The attitude of students towards ICT or learning content management systems is also an important factor in ICT learning. With newly developing multimedia technologies, incorporating simultaneous presentations of narration, images, and text, the possibilities for instruction are vast. Yet, how and when should educators use these technologies in the most effective ways to enhance learning? This is the main question behind this research: What is the effectiveness and usefulness of using ICT learning approach in teaching the Mathematics for 8th grade students? In this study, an experimental group of (48) students was examined after studying a course using ICT approach. The instructional design approach was used. The researcher has used the Khamis Instructional Design Model (2003) since it was proved to be simple and efficient. The course was implemented using MOODLE-LMS. The students' achievement was examined before and after the experiment. The research results proved that there is a significant increase in Gain in Achievement. The ICT learning has achieved efficiency greater than (80%) in achievement. Also, the ICT learning has achieved efficiency greater than (1.2) measured with respect to Black's Gain Ratio in achievement. Also, the ICT learning has achieved efficiency greater than (0.6) measured with respect to McGugian's Gain Ratio in achievement. The ICT learning has achieved larger effect size (more than 0.14) on achievement.

Key words: ICT, students' achievement, pretest, posttest, t-test.

INTRODUCTION

No one can deny that advances in information technology coupled with the changes in society, are creating new paradigms for education and training. These changes will affect our education and training systems. Participants in this educational and training paradigm, require rich learning environment supported by well-designed resources (Khan, 1997). Therefore, there is a great demand for affordable, efficient, easily accessible, open, flexible, learner-centered and facilitated learning environment. Hall (2001) reports that "e-learning is the fastest growing and most promising in the educational industry".

Actually, there is a great debate about whether it is the use of a particular delivery technology or the design of

the instruction that improves learning (Clark, 2001; Kozma, 2001). It has long been recognized that specialized delivery technologies can provide efficient and timely access to learning materials; however, Clark (1983) has claimed that technologies are vehicles that deliver instruction, but they do not influence student achievement. Similarly, Schramm (1977) suggested that learning is influenced more by the content and instructional strategy in the learning materials than by the type of technology used to deliver instruction.

It is widely used in schools, universities and other organizations all over the world, either to support classroom learning or on its own. The Palestine schools and Universities are no exception. Usually, a special kind

of web-based content management system is used for running e-learning courses. These systems hold all the course content and information of the students and also provide the interactive tools to support learning process. While using such systems makes the ICT learning experience much easier, it also induces some problems like the heterogeneous previous knowledge of the students. In many cases, this can be an obstacle, especially in such courses, where the students are from different faculties, or in adult learning situations. This is also a problem in the regular classroom education, but even more so in e-learning, where the participants can be from all over the world. The attitude of students towards e-learning or learning content management systems is also an important factor in ICT learning.

According to (Bonk and Reynolds, 1997), to encourage thinking on the e-learning, challenging activities that enable learners to link new information to old, and acquire meaningful knowledge must be created; hence, it is the instructional strategy and not the technology that influences the quality of learning. Kozma (2001) argues that the particular attributes of the computer are needed to bring real-life models and simulations to the learner; thus, the medium does influence learning. However, it is not the computer per se that makes students learn, but the design of the real-life models and simulations, and the students' interaction with those models and simulations. The computer is merely the vehicle that provides the processing capability and delivers the instruction to learners (Clark, 2001).

It is well known that Mathematics is an important field, play a main role in our life. There is difficulty for students to achieve good scores and to be interactive in the classroom during the lectures so it is important to use the computer-based learning to overcome these problems. ICT learning using computer tools, internet and, interactive multimedia based on instructional computer will enhance the education process and increase the efficiency especially if designed under the control of the Instructional System Design theory.

THE RESEARCH PROBLEM DEFINED IN THE FOLLOWING QUESTION

What is the effectiveness and usefulness of using ICT in learning approach in teaching Mathematics for 8th grades students?

The research importance

This study is an important contribution to the research of understanding how to use ICT learning and web-based multimedia instruction. Schools and universities are using the Internet and "www" more and more to deliver instruction, and instructors and courseware designers

need to have valid information on what technologies are available and how to use them to improve student learning. Students of the "Net Generation" expect and demand high quality, fully accessible course materials available online. Decisions to purchase e-learning and multimedia software by university departments can be justified through this research. Software companies would gain feedback about the usefulness of their products in an educational setting.

The Mathematics is one of the essential subjects. Using ICT learning approach is important to teach it. The efficiency of the suggested program will be determined. The student's attitudes toward this technology will be studied. Student's feedback will be analyzed to determine future plans concerning this type of learning. School technological facilities and educational development strategies may be changed according to the research results.

The research hypothesis

1. There are no significant differences at level of ($\alpha \leq 0.05$) between the mean scores of the achievement of pretest and posttest.
2. Learning based on ICT has efficiency in achievement not less than 80%.
3. Learning based on ICT has efficiency in achievement not less than 1.2 as measured with respect to the modified Black's Gain Ratio.
4. Learning based on ICT has efficiency in achievement not less than 0.6 as measured with respect to the McGugan Gain Ratio.
5. Learning based on ICT has an effect size on achievement not less than 0.14.

RESEARCH METHODOLOGY

The research was carried out using the experimental methodology in which the 48 student were treated as an experimental group. This group had studied Mathematics using the (MOODLE) platform Learning Management System.

Experimental design

The Researcher has used a pretest- posttest experimental design. One experimental group with pretest-posttest were timed and taken on computers using the testing module of the course management system in Moodle. All students were experienced with the testing format of the Moodle. Test questions on pre- and post-tests were identical. Test answers were not revealed on the pre-test. The test questions were derived from a pool of questions bank designed by the researcher.

Table 1. Descriptive statistics for achievements pretest-posttest.

Test	N	Mean	Standard deviation
Pretest	48	16.27	4.59
Posttest	48	25.21	3.19

Table 2. Achievement dependent (Paired) samples t- test.

Achievement	N	Mean	Standard deviation	t-value	df	p-value
Pretest	48	16.27	4.59	6.127	47	0.001
Posttest	48	25.21	3.19			

Variables calculations and statistical processing

After completing the experiment, the data analyzed was collected. The following relations were used in this research to measure the students' gain in achievement after studying the biomedical instrumentation course using the e-learning approach.

1. Gain = posttest-grade – pretest-grade
2. Modified Black's Gain Ratio:

$$\text{Black's Gain Ratio} = (Y-X)/(D-X) + (Y-X)/D$$

Where:

Y = grade of post-test

X = grade of pre-test

D = test maximum grade (30)

This ratio interval is [0, 2] and the instructional program is considered acceptable if the computed ratio is not less than 1.2., (Roebuck, 1973).

3. McGugian Gain Ratio:

$$\text{McGugian Gain Ratio} = \text{Real Gain/Expected Gain}$$

$$\text{McGugian Gain Ratio} = (Y-X)/(P-X)$$

Where:

Y = average of post-test grade

X = average of pre-test grade

P = test maximum grade (30)

This ratio interval is [0, 1] and the instructional program is considered acceptable if the computed ratio is not less than 0.6, (Roebuck, 1973: 472-473).

4. Effect Size: How much change the independent variable will affect the students' achievement in studying.

In this research mean how much change the ICT learning

approach will affect Mathematics 8th grade students' achievement in studying the math instrumentation course.

Statistically, the square of eta (η^2) will be used. $D = t^2/(t^2 + df)$, t-value with degrees of freedom df. This factor should be greater than 0.14.

RESULTS

When examining descriptive data concerning the pretest and posttest achievement scores (Table 1), it was noticed that there is an increase in the mean of scores by (53.071) after the application of the elearning of the course. This value represents the gain in students' achievement. Also, it is well-known that the standard deviation is a measure of how well the mean represents the data. Small standard deviation (relative to the value of the mean) indicates that the data points are close to the mean. A large standard deviation (relative to the value of the mean) indicates that the data points are distant from the mean, or that the mean is not an accurate representation of the data. As seen in Table 3, the standard deviation in the posttest (5.919) is reduced compared to the standard deviation in the pretest (9.153), which means less data variations and pointed out that the student's scores are around the mean (82.43).

Paired samples statistics

To check the validity of the first hypothesis that stated (There are no significant differences at level of ($\alpha \leq 0.05$) between the mean scores of the achievement of pretest and posttest), the paired samples (dependent) t-test was run on the SPSS-13 program to determine any significant differences between post- and pre- test scores. The results are shown in Table 2. It is clear from this table and Table 1 that the mean in the scores is increased from (25.21) to (16.27) by a difference of (8.94).The statistical significance less than (0.001). This is less than the

Table 3. Achievement one sample t- test.

Test Value = 80						
Achievement	N	Mean	Standard deviation	t-value	df	p-value
Posttest	48	25.21	3.19	11.07	47	0.149

Table 4. Achievement Black's Gain Ratio

	N	Minimum	Maximum	Mean	Std. Deviation
Black's Gain	48	1.22	1.41	1.2878	0.05771

Table 5. Achievement McGugian gain ratio.

	N	Minimum	Maximum	Mean	Std. Deviation
McGugian Gain	48	0.69	0.89	0.7571	0.05934

claimed level of significance ($\alpha \leq 0.05$), therefore the null hypothesis is rejected and the alternative hypothesis is accepted that there is a significant difference at level ($\alpha \leq 0.05$) between the mean scores of the achievement of pretest and posttest, favoring the posttest).

One-sample t-test

To check the validity of the second hypothesis that stated (learning based on ICT has efficiency in achievement not less than 80%), the one-sample t-test was run to determine whether a difference exists between the posttest scores after application of elearning on the course and the test value of (80%). The results are shown in Table 3. The computed t-value equals (1.535) at degree of freedom equals (13) with statistical significance (0.149). It is clear that there is no significant difference between the posttest scores and the degree 80% (posttest mean = 25.21). Therefore the null hypothesis is accepted that is learning based on ICT has efficiency in achievement not less than 80%.

Achievement Black's Gain ratio

To check the validity of the third hypothesis that stated (learning based on ICT has efficiency in achievement not less than 1.2 as measured with respect to the Black's Gain Ratio), the gain is calculated for each student based on the equation specified in variables calculations and statistical processing. The mean and standard deviation of this gain is calculated and shown in Table 4. It is clear from this table that the calculated mean of Black's Gain Ratio equals (1.2878) which is greater than the reference

value (1.2). This implies that learning achieves efficiency greater than Black's Gain Ratio that is accepting the null hypothesis.

Achievement McGugian gain ratio

To check the validity of the forth hypothesis that stated (learning based on ICT has efficiency in achievement not less than 0.6 as measured with respect to the McGugian Gain Ratio), the gain is calculated for each student based on the equation specified in variables calculations and statistical processing. The mean and standard deviation of this gain is calculated and shown in Table 5. It is clear from this table that the calculated mean of McGugian Gain Ratio equals (0.7571) which is greater than the reference value (0.6). This implies that learning using ICT achieves efficiency greater than McGugian Gain Ratio that is accepting the null hypothesis.

Effect Size of e-learning on achievement

To check the validity of the 5th hypothesis that stated (learning based on ICT has an effect size on achievement not less than 0.14). The square of (η) is calculated and summarized in Table 6. The square of (η) equals 0.723 which is greater than the reference value (0.14). This implies acceptance of the claimed hypothesis.

Conclusions

The main goal of any learning activity is for learning to

Table 6. Effect size of ICT learning on achievement.

N	t-value	df	η^2	Effect Size
48	6.127	13	0.723	large

Table 7. Research hypothesis results.

Hypothesis number	Metric tool	Metric tool reference - value		Decision
1	Gain in Mean	-	53.07	Rejected
2	Efficiency	80%	82.43%	Accepted
3	Black's Gain Ratio	1.2	1.2878	Accepted
4	McGugian Gain Ratio	0.6	0.757	Accepted
5	Effect Size	0.14	0.723	Accepted

take place in an efficient. A common way to measure the effectiveness of instruction is to measure learner achievement. Measuring learner achievement in ICT learning environments requires special attention. In fact, traditional methods for measuring learner achievement can be applied to ICT learning courses with some forethought and modification. Quizzes, exams, team and individual projects, as well as written assignments, can all be used in ICT learning Subjects and courses. The use of electronic mediums can even make grading of tests and quizzes easier because scores can be tabulated immediately following the completion of a quiz or test, providing quick and accurate feedback to learners.

When examining the descriptive data concerning the achievement pretest and posttest scores, it was found that there is an increase in the mean of scores by a gain value (8.94) after the application of the ICT learning of the subject. Also, the standard deviation in the posttest is reduced compared to the standard deviation in the pretest which means less data variations and pointed out that the student's scores are around the mean (25.21). Therefore the first hypothesis stated that (There are no significant differences at level of ($\alpha \leq 0.05$) between the mean scores of the achievement of pretest and posttest) is rejected. The validity of the second hypothesis stated that (learning based on ICT has efficiency in achievement not less than 80%) was accepted after the application of one-sample t-test between the posttest scores after application of learning on the course and the test value of (80%). The validity of the third hypothesis stated that (learning based on ICT has efficiency in achievement not less than 1.2 as measured with respect to the modified Black's Gain Ratio) was accepted since the calculated Black's Gain Ratio equals (1.2878) is larger than the reference value (1.2). The validity of the forth hypothesis stated that (learning based on ICT has efficiency in achievement not less than 0.6 as measured with respect to the McGugian Gain Ratio) was accepted since the calculated McGugian

Gain Ratio equals (0.757) is larger than the reference value (0.6). The validity of the fifth hypothesis stated that (e-learning based on internet has an effect size on achievement not less than 0.14) was accepted since the calculated effect size equals (0.723) is larger than the reference value (0.14). These conclusions are summarized in Table 7.

From this discussion, it is clear that learning in ICT approach has good efficiency in learning and improves the students' achievement toward this new systematic way of learning using the new technology based on computer and multimedia tools. After the results of the research have been lighted, the researcher suggests the following points:

- The learning ICT approach should be used in our Schools and Universities, especially occupation military barriers are usual.
- The computer Labs should be developed and moderned.
- The infrastructure for Internet should be increased.
- Use the instructional design models
- Execute practical sessions for students of all levels concerning use of LMS.
- Encourage instructors to practice the learning ICT approach and use LMS.
- Establish an authoring unit for learning ICT of different subjects and courses with different experts.

REFERENCES

- Bonk CJ, Reynolds TH (1997). Learner-centered Web instruction for higher-order thinking, teamwork, and apprenticeship. In Khan BH (Ed.), Web-based instruction. Englewood Cliffs, NJ: Educational Technology Publications. pp. 167-178.
- Carr Jacobson, Brown M (1993). Introduction to Biomedical Equipment Technology, 2nd edition,

- Prentice Hall Inc.
- Clark RE (2001). A summary of disagreements with the "mere vehicles" argument. In Clark RE (Ed.), *Learning from media: Arguments, analysis, and evidence*. Greenwich, CT: Information Age Publishing Inc. pp. 125-136
- Hall B (2001). *e-learning: Building competitive advantage through people and technology*. <http://moodle.org/doc/>
- Khan B (1997). *Web-based instruction: What is it and why is it?* In Khan BH (Ed.), *Web-based instruction*. Englewood Cliffs, NJ: Educational Technology Publications. pp. 5-18
- Kozma RB (2001). Counterpoint theory of "learning with media." In Clark RE (Ed.), *Learning from media: Arguments, analysis, and evidence*. Greenwich, CT: Information Age Publishing Inc. pp. 137-178
- Simmons DE (2002). The forum report: E-learning adoption rates and barriers. In A. Rossett (Ed.), *The ASTD e-learning handbook*. New York: McGraw-Hill. pp. 19-23.