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ABSTRACT

Technology has become a part of most of our activities in the everyday life. It entered to the educational field as well as the other fields. The use of technology in school is growing in both technological equipments like computers and the structure for them, besides the training programs for the teachers and other users. The new technological tools, such as computers and their software, provide people with more opportunities to teach in new ways. This environment of using technology is growing in the general reform in mathematics education. The purpose of this study was to investigate the effect of using the Geometer's Sketchpad (GSP) on students' understanding of some of the geometrical concepts. The sample consisted of 52 students from the Model School, Yarmouk University, Jordan. The students in the control group used only the book. Both groups took the same pretest and posttest, which was designed by the researcher. The results of the study indicated that there was a significant difference between the means of the students' scores on the posttest with favor to the experimental group. The results also indicated that there were more gain in the scores from the pretest to the posttest in the case of the experimental group. The researcher suggested more use of the GSP software and more investigations in the area of using computers in education. (Author)

The Effect of Using the Geometer's Sketchpad (GSP) on Jordanian Students' Understanding of Geometrical Concepts

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ABSTRACT:

Technology has become a part of most of our activities in the everyday life. It entered to the educational field as well as the other fields. The use of technology in schools is growing in both technological equipments like computers and the structure for them, besides the training programs for the teachers and other users. The new technological tools, such as computers and their software, provide people with more opportunities to teach in new ways. This environment of using technology is growing in the general reform in mathematics education.

The purpose of this study was to investigate the effect of using the Geometer's Sketchpad (GSP) on students' understanding of some of the geometrical concepts. The sample consisted of 52 students from the Model School, Yarmouk University, Jordan. The students in the experimental group used the GSP software once a week and the book, while the students in the control group used only the book. Both groups took the same pretest and posttest, which was designed by the researcher.

The results of the study indicated that there was a significant difference between the means of the students scores on the posttest with favor to the experimental group. The results also indicated that there were more gain in the scores from the pretest to the posttest in the case of the experimental group. The researcher suggested more use of the GSP software and more investigations in the area of using computers in education.

Technology is one of the major aspects in the educational process in all levels. It is "not only a product of a given culture; it also shapes the culture that created it" (Mehligner, 1998, p.8). The new technologies such as computers might affect the schooling system- if they are used in the right way- because technology provides learners (students) the power of controlling what they are learning. While teachers and administrators had the power in the past to determine what would be taught and what would not be taught.

Computers' use is in an increasing rate all over the world. The ratio of the number of students to the number of computers has been changed from 125:1 to 10:1 in the twelve-year span ending in 1996 in the United States (Quarterly Educational Data, 1996). "Growth is also an evident in the computer-related products ((Video-Disk Players, CD-ROM Players, Local Area Networks) and computer-independent forms of technology (Cable TV access was added in the nearly 20% of schools in three years- 76% of the US school districts have cable)" (Grabe and Grabe, 1998, p.10). Computers might be used to teach, to facilitate studying several topics, to help students to learn how to use technology, and to increase the effectiveness of performing academic tasks (Becker, 1991).

This study focuses on using one of the computer's software, the Geometer's Sketchpad (GSP) (Jackiw, 1991), on students' understanding of some of the geometrical concepts in mathematics. It gets its importance from the results of the 1994 study commissioned by the Software Publishers Association. Some of the conclusions of that study were the following:

Educational technology has a significant positive impact on achievement in all subject areas, across all levels of school, and in regular classrooms as well as those for special-needs students.

Educational technology has positive effects on students' attitudes.
Technology makes instruction more student-centered, encourages cooperative learning, and simulates increased teacher-student interaction (Mehligner, 1998, p.12).

The GSP is an interactive and dynamic computer program that can be used to help students learn and understand geometrical concepts and principles. "The GSP lets the user explore simple, as well as highly complex, theorems and relations in geometry" (Giamatti, 1995, p.456). It also "has the ability to record students' constructions as scripts. The most useful aspect of scripting ones' constructions is that students can test weather their constructions work in general or weather they have discovered a special case" (p.450). In addition, the GSP software provides the process of learning and teaching mathematics by a remarkable help because "the power of the GSP combined with the power of proof gives a complete illustration of the theorem involved and the aspects of "doing" mathematics" (p.458).

Students have many reasons for making a sketch with the GSP. "Their purpose may be to explore the behavior of a particular geometric figure, such as a rhombus, or to model a physical situation, such as a ladder leaning against a wall. They may want to make a beautiful pattern inspired by Navajo rug designs, or their goal may be an animation-perhaps a Ferris wheel or a merry-go-round" (Finzer and Bennett, 1995, p.128). The most important thing about the GSP Software is that GSP is an active dynamic program with a useful feature by using the mouse interface for graphics and high speed.

This study tried to answer the following questions:

1. Are there any differences between the means of the pretest and the posttest for the experimental group?

2. Are there any differences between the means of the pretest and the posttest for the control group?

3. Are there any differences between the means of the pretest for the experimental group and the control group?

4. Are there any differences between the means of the posttest for the experimental group and the control group?

Previous Studies:

Because the Geometer's Sketchpad was discovered in the recent years, only few research studies were done in its area. In the same time, most of the effort that was done, so far, focused on providing the teachers and students by some good examples of how using the GSP software in mathematics. Here is a summary of the some of these studies.

Dixon (1996) conducted a study and concluded that students who used the GSP (dynamic instructional environment) had higher significant achievement scores on a test containing the concepts of reflection and rotation. Groman (1996) studied using the GSP in a Geometry Course for Secondary Education Mathematics Majors and offered three examples of how sketchpad is used. The findings of the study showed that students wanted to get their own copies of the GSP software. The use of the GSP showed more positive reaction from both the students and the instructors in testing conjectures and constructions.

Youssef (1997) conducted a study to investigate the effect of using the GSP on the high school students' attitudes towards geometry. One of the results of that

study indicated that the scores of the pretest and posttest of the students in the experimental group were significantly different. Another result indicated that there was a significant difference between the control and experimental groups in the gain of the scores from the pretest to the posttest.

Lester (1996) conducted a study to investigate the effects of the GSP software on achievement of geometric knowledge of high school geometry students. The results indicated that the mean of posttest scores for the dependent variable (geometric conjectures) of the experimental group was significantly higher than that of the control group. According to the same study, the GSP provides intelligent capabilities for improving learning and teaching. In addition, Lester's study raised the issue of preparing qualified teachers in using the new technologies and software in an effective way.

In general, the results of the studies and the discussions about the use of the GSP in teaching and learning mathematics indicated that it is a useful and attractive program that can create a healthy atmosphere in the educational process. Because using this program will provide students by a good chance of simulation, which is very close to the real life situations. In addition, Mehligner (1998) stated that in order to get the maximum benefit from technology, "schools should expect more integration, interaction, and intelligence from future technology" (p.12).

Procedure:

The population of the study was the Jordanian students in the 9th grade who study some of the geometrical concepts, principles, and constructions. The sample of the study consisted of 52 students in the 9th grade at the Model School of Yarmouk University, Irbid, Jordan in the academic year 1999/2000. There were 26 students in the experimental group and 26 students in the control group. Both groups were being taught by the same teacher. The experimental group studied the geometrical part of the curriculum by using the book and the Geometer's Sketchpad (GSP) software, while the control group studied the same part using only the book. The students in the experimental group used the GSP once a week during the first semester of the academic year 1999/2000.

At the end of the experiment, all students in the sample took a test measuring their understanding of some of the geometrical concepts focusing on the relationship between the area and the perimeter of polygons such as rectangles and triangles (Appendix A). The instrument (achievement test) used in this study was designed by the researcher, and indicated that it was a valid one by some of the mathematics educators in Jordan.

There were four hypotheses in the study:

1. There is a significant difference between the means of the pretests and the posttests for the experimental group.
2. There is a significant difference between the means of the pretests and the posttests for the control group.
3. The mean of the pretest results for the experimental group is equal to that for the control group.
4. The mean of the posttest results for the experimental group is greater than that for the control group.

In order to study these hypotheses, the researcher found the means of the students' results in both groups on the pretest and the posttest, and used the ANCOVA test to compare and analyze the results.

The Results and Discussion:

This research was designed to study the effect of using the GSP on students' understanding of some of the geometrical concepts. The correlations between the means of the students' results on the pretest and the posttest of the control group, the experimental group, and the whole sample group were 0.966, 0.758, 0.681, respectively. According to Tables (1), (2), and (3), all of these results were significant at the 0.01 level (2-tailed). This result can be understood by looking carefully to the students' understanding of the geometrical concepts in both groups. The students in the control group did not gain more scores from the pretest to the posttest, which might be explained by using the regular way of teaching and learning, which is using only the book without using the computer. While the students in the experimental group gained more scores from the pretest to the post test, which refers to their use of computers and the GSP program. These results goes with the results of other studies (Dixon, 1996, and Yousef, 1997).

Correlations[a]

		PRETEST	POSTEST
Pearson Correlation	PRETEST	1.000	.966**
	POSTEST	.966**	1.000
Sig. (2-tailed)	PRETEST	.	.000
	POSTEST	.000	.
N	PRETEST	26	26
	POSTEST	26	26

**. Correlation is significant at the 0.01 level (2-tailed).

a. group = control group

Table (1): The Correlations between the Pretest and the Posttest for the Control Group

Correlations[a]

		PRETEST	POSTEST
Pearson Correlation	PRETEST	1.000	.758**
	POSTEST	.758**	1.000
Sig. (2-tailed)	PRETEST	.	.000
	POSTEST	.000	.
N	PRETEST	26	26
	POSTEST	26	26

**. Correlation is significant at the 0.01 level (2-tailed).

a. group = experimental group

Table (2): The Correlations between the Pretest and the Posttest for the Experimental Group

Correlations

		PRETEST	POSTEST
Pearson Correlation	PRETEST	1.000	.681**
	POSTEST	.681**	1.000
Sig. (2-tailed)	PRETEST	.	.000
	POSTEST	.000	.
N	PRETEST	52	52
	POSTEST	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

Table (3): The Correlations between the Pre-test and the Post-test for the Whole Sample Group

In Table (4), the results of the descriptive statistics indicated that the mean of the post-test results was 41.5385 for of the control group, while it was 68.6538 for the experimental group. Figure (1) also gives another perspective of this significant difference. In the same time, the results showed that the scores of the experimental group students on the post-test were more deviated than those of the control group. In addition, the standard deviation of the scores for the whole sample group was larger than that of both groups. This result can be understood by combining together all the scores of the tests of both groups.

Descriptive Statistics

	group	Mean	Std. Deviation	N
POSTEST	control group	41.5385	15.0844	26
	experimental group	68.6538	21.0978	26
	Total	55.0962	22.7409	52

Table (4): Descriptive Statistics for the Control and the Experimental Groups

Table (5) showed the results of the ANCOVA test. All F values in this study were significant under the 0.05 level. This result showed that the use of the GSP had the effect on students' understanding of the geometrical concepts, and other research studies support it. On the other hand, the pairwise comparisons showed that mean differences were significant under the 0.05 level, which can be considered as another evidence of the results of this study.

Tests of Between-Subjects Effects

Dependent Variable: POSTEST

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power[a]
Model	179105.161[b]	3	59701.720	571.382	.000	1714.146	1.000
PRETEST	11696.507	1	11696.507	111.943	.000	111.943	1.000
GROUP	10289.292	2	5144.646	49.237	.000	98.475	1.000
Error	5119.839	49	104.487				
Total	184225.000	52					

a. Computed using alpha = .05

b. R Squared = .972 (Adjusted R Squared = .971)

Table (5): ANCOVA Test for the Dependent Variable (Posttest)

Pairwise Comparisons

Dependent Variable: POSTEST

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
control group	experimental group	-26.3329*	2.836	.000	-32.032	-20.634
experimental group	control group	26.3329*	2.836	.000	20.634	32.032

Based on estimated marginal means

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

Table (6): Pairwise Comparisons

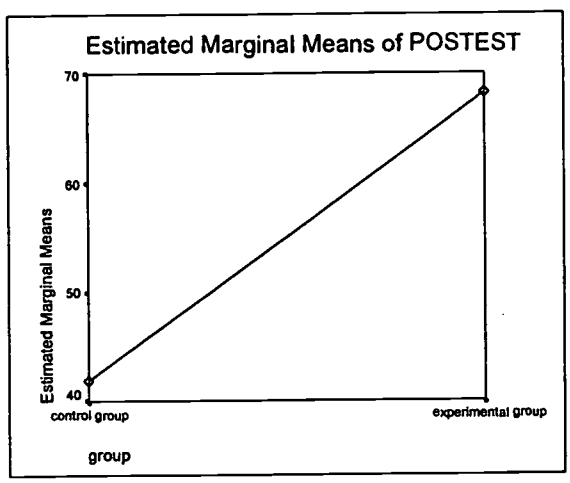

Figure (1): The Profile Plots

Recommendations:

According to the results of this study, the researcher had some suggestions and recommendations:

1. This study had the sample from students in the 9th grade. This means that there is a need for further studies in other grades and levels.
2. The sample of the study consisted only males. It is recommended to conduct other studies in the same area with samples from both males and females.
3. Since this study as well as other previous studies concluded that there was a significant effect of using the GSP software, the researcher recommends more emphasize on the use of computer and its programs in mathematics and in education.
4. The GSP is one of the latest computer programs in the mathematics area. It is recommended to evaluate its features and capabilities.

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