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The Effect of Using Computerized 5E's Learning Cycle Model on Acquiring Scientific Concepts among Fourth Graders

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Abstract The purpose of this study was to investigate the effect of using computerized 5E's learning cycle model on acquiring scientific concepts and scientific thinking skills among fourth graders in Islamic Educational College/ American Program, Scholastic Aptitude Test (SAT) during the second semester (2015/2016). The researcher prepared a Scientific Concepts Test. A quasi-experimental design was applied on the sample of the study which consisted of (48) fourth graders. Two classes were randomly assigned as control and experimental groups. Students in the experimental group (24) were taught by using computerized 5E's learning cycle model strategy, while in the control group (24) students were taught by using conventional 5E's learning cycle model strategy. All students were pre-and post-tested with the (Matter, & Electricity and Magnetism) units. The study revealed that there were statistical differences at the level of (α = 0.05) on acquiring scientific concepts in favor of computerized 5E's learning cycle model strategy. While there were no significant differences due to the interaction between the strategy of teaching and gender (male, female). In light of study results, some recommendations were presented.

Keywords: *scientific concepts, computerized (5E's) learning cycle, fourth graders*

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1. Problem and Significance of the Study

1.1. Introduction

Learning theories indicate to the change of the roles of teachers and learners in general; it is not anymore accepted that the teacher continues in his traditional role providing the learners using the way of sponge-feeding for knowledge, fact and concepts. In addition, a teacher is not anymore considered the only source for knowledge, he has become a facilitator and a guide for students. On the other hand, the learner (according to the constructive theory) is to explain his own vision and knowledge, since this theory is based on a belief that learners build and explain knowledge each according to his/ her own method through interaction with the natural phenomenon and with the other people around them [9]. In this regard, the task of teach science is not an easy one since is has hopes and expectations in building a general that is capable to perform creative scientific thinking and to cope with the scientific development and the huge revolution in knowledge during this era (Garfes, 1999).

Therefore, and due to the importance of the scientific concepts, educators have been active in searching for methods and strategies that improve teaching at all levels. Such efforts produced modern teaching models that focused on providing the students with the skills of scientific thought and activities as well as the positive active student role in the learning- teaching process, instead of concentration on the quantity of the scientific content [5,8].

In this context, the importance of learning cycle has increased in light of the development of the educational computer due to its various advantages in integrating the learning and teaching processes such as reality, imagination, safety, gravity, beauty, ability to control, dealing with various means, shortcut of time during the learning and teaching process and evaluating the students to have direct results of their productions which will save the time and effort of teachers and learners.

In order to have an efficient strategy for the learning cycle (the computerized 5E's learning cycle) in teaching scientific concepts for the students, the need emerged to study the effect of using the 5E's learning cycle strategy (the computerized) compared with the traditional (5E's learning cycle strategy) in teaching scientific concepts and skills for the 4th grade students in the schools of the Islamic Educational College which apply the SAT (the American Program).

1.2. Problem and Questions of the Study

Through field observations for the students, the two researchers noted lower levels of performance in terms of the scientific concepts. This has been confirmed through

the study of the UNESCO [7] as the 4th grade students (the Arab students) are generally weak in the mathematical and scientific capacities, as the levels of students were bellow the international level among the participant countries.

In addition, the results of The Program for International Student Assessment (PISA) indicated that the performance of the students of East Asia was much better than the students of other countries. However, as for the Arab countries, Jordan occupies the rank (61), as reading and scientific indicators witnesses notable retreat the Organization for Economic Co-operation and Development [29].

Based on the above, the problem of the study is to investigate the effect of using the five-cycle computerized method in providing the 4th grade elementary stage students with the scientific concepts, compared with the traditional learning cycle (5E's learning cycle). Specifically, this study intended to answer the following main question:

What is the effect of using the computerized 5E's learning cycle strategy in providing the 4th grade students with the scientific concepts and skills of scientific thinking?

Since it is believed that the effect of the strategy might be altered or changed with the change of gender, the following sub-questions emerged from the main question:

First question: Does the level of gaining scientific concepts with the 4th grade students differ with the difference in the teaching strategy (the computerized 5E's learning cycle and the traditional one)?

Second question: Does the level of gaining scientific concepts with the 4th grade students differ with the difference in the teaching strategy (the computerized 5E's learning cycle and the traditional one) due to gender (male/ female)?

1.3. Significance of the Study

This study is consistent with the trends of the Ministry of Education to computerize the scientific curriculum and follow up and application and experimenting these computerized courses in the schools, while activating the scientific projects such as (Try Science) and Trends in International Mathematics and Science Study (TIMSS), 2011, not to forget the need to expand the base on participation in the international evaluation studies especially in the fields of reading, math, and science (Program for International Student Assessment) "PISA" [8]. This study stems from two main aspects: the theoretical and applied aspects.

The applied importance of the study is represented in the following:

First: providing teachers of science with procedural steps to practice teaching through using the 5E's learning cycle computerized circle, which will improve their teaching capacities and performance inside the classroom.

Second: help the officials who supervise science curriculum when reviewing the development of scientific curriculum to plan and prepare them in accordance with the 5E's learning circle term.

Third: this study might be a motive for scholars and those who are concerned with the science curriculum and teaching methods, to investigate the effect of using other computerized teaching constructive teaching methods, and to show their effect on other variable such as: development of attitude towards science and developing the critical and creative thinking skills.

Keywords: The study discussed the following terms:

The ordinary fifth-circle cycle: One of the teaching and learning models that are based on the constructivist philosophy (Bybee Constructive model). It consists of five stages starting with the letter (E) as shown in figure (1). Therefore, it is called (5E's) referring to: Engagement. Exploration, Explanation, Elaboration and Evaluation [1];

The five learning computerized cycle: A teaching material that is prepared and planned within the school book (Interactive Science). It relies on the computer in accordance with the strategy of the 5E's learning cycle since it is a teaching means based on using multi- media, where it is deemed an interactive means with the students. In addition, it relies on imitation and this material discussed two units namely (Matter and Electricity and Magnetism) from the text book of the forth primary grade (SAT).

Procedurally: it is an interactive material between the students and the five computerized material that is based on multi-media and begin with preparation, exploration, explanation, elaboration and ends with evaluation.

Gaining scientific concepts- Procedurally: the grade which a student got in the test of scientific concepts mentioned in the two units (Matter and Electricity and Magnetism) that were specially prepared for this purpose.

Limitations of the study disadvantages: The study was implemented and its results were generalized in light of the following limitations and disadvantages:

1. The study was limited on the 4th grade students (age group 9-10 years) in the Islamic Educational College /American program, Scholastic Aptitude Test (SAT).
2. The study was limited within two classes of the 4th grade, who are randomly distributed to the groups of the study.
3. The study was limited to measure the extent of gaining the scientific concepts mentioned in the two units (Matter & Electricity and Magnetism). These concepts are:

(Properties, matter, phase of matter, mass, density, volume, gravity, chemical change, physical change, electric current, circuits, series circuits, parallel circuits, insulator, conductor, resistor, energy, energy transformation, incandescent, light bulb, fluorescent light bulb, magnetic poles, magnetism, electromagnet and generator).

4. The study was implemented during the second academic semester 2015- 2016.
5. The degree of result generalization was decided in terms of validity and reliability of the instruments used and the seriousness of the respondents thereof.

1.4. Literature Review and Previous Relevant Studies

The primary stage is considered an important one in student's lives in terms of forming an organized cognitive structure. This is related to the amount of concepts they learn, and therefore, learning concepts is one of the factors

that influence the efficiency of learning and increasing the cognitive store, which in turn, generate new knowledge and increase the ability to keep and retrieve knowledge [15].

Consequently, concept learning is an important educational objective at all learning levels (The Scientific Educational Encyclopedia, 2004), which include:

1. Sensual concepts: the concepts that have sensual examples and students can touch, see and smell (e.g. the flower, pencil.. etc);
2. The abstract concepts: which have no sensed examples and students need mental capacities to comprehend (e.g. atom, particles .. etc.).

In this regard, the scientific concepts are the basis and essence of scientific curriculum and teaching methods during childhood, especially that students are members of the sensual stage (according to Piaget classification). In this context, students may learn the scientific concepts in such a way that is consistent with the children's cognitive level; gaining and development of concepts depends on the degree of interaction with the live and sensual experiences in the classroom [20,22].

On the other hand, the most important factor for learning is the previous things a learner knew, meaning the former knowledge he/ she has and to link them with the new information. This was indicated by Jabir, [2] who agrees with Ozopel's theory in the meaningful learning as good learning is the one which link the concepts and issues with the previous experiences students have.

Due to the importance of learning and gaining concepts during the primary stage, the project "The American Association for the Advancement of Science AAAS, 1993" on reforming teaching science recommended to provide care for children to learn and understand the scientific concepts [4]. This care is due to the spread of alternative of the students' mistaken understanding for learning scientific concepts. The results of the third international evaluation for math and science showed weakness in gaining the scientific concepts. This can be attributed to the inactive teaching practices [23].

Furthermore, the use of computer in teaching scientific subjects contributes in the sensual embodying of the concepts due to the abstract contents contained in the scientific books.

In addition, the results of the studies and research confirmed the significant role of using computer in facilitating the process of learning and gaining scientific concepts [27].

However, the role of computer is not limited in improving the students' achievement, but in addition to that, the studies showed that using computer in teaching provides self- learning opportunities that contribute in gaining scientific concepts. This relies on the extent of practice, exercise and the feedback provided to the students [16].

Atyieh and Srour present the conditions of the efficient learning, which include:

First: the existence of large variations in the students' capacities in comprehending the concepts due to the large differences in their development levels.

Second: scientific concepts learning takes place as a result for the student's interaction with the things; conceptual learning is linked with the students' development level.

Third: the direct oral learning has a limited effect in increasing the students' abilities in the conceptual comprehension for the problems and issues that have requirements above their currents development capacities, which also have a limited effect in making progress in the development levels.

Within this vein, Trowbridge, Bybee and Carlson, [32] believe that there is a need for the teacher to possess a good cognitive base about the content of the subject matter. This teacher will use appropriate teaching strategies so as to achieve an efficient teaching for science.

In fact, the developed science curriculum for the primary stage was developed to include a series of ideas, theories and modern educational strategies, mainly the reliance of science curriculum on the national education scientific standards in USA (National Science Educational Standard), which include:

- Including a series of the scientific content in the natural, life and ground sciences which achieve the national standards for each grade level.
- Confirming on giving opportunities for the students to use the tools and methods of scientific thinking in each class, which always begins with a practical activity.
- Adding useful and interesting aspects in science and technology as per the scientific field that will be taught.
- Confirming the history and nature of science, and the endeavors of scientists.
- Conforming the importance of the student and his active role in the learning process; the educational materials are designed so as to provide a wide space for students to practice the skills of scientific induction and to gain scientific skills through preliminary scientific activities, the extended experiments as well as practicing the scientific search and investigation outside the classroom and from the scientific projects, so that the learner will embody the methods of scientists and practice that him-self.

Many educators and scholars in the field of curriculum and teaching methods stated to the features of scientific curriculum in the 21st century [26,34]. These features include:

1- Completeness among the valuable and social aspects of science and technology in the scientific curriculum.
2- Presenting science curriculum in such a way that shows the relationship between science, technology and community.
3- There is a change from the specialized academic trend towards the interdisciplinary trend which deals with interaction between Science, Technology and Society (STS).
4- Agreement on a thematic methodology for basic topics that confirm the standards of choosing the content of the national scientific curriculum in accordance with the Scope, Sequence and Coordination.
5- Completeness and link in a more comprehensive way among the various scientific curriculum to develop the communication skills, creativity and gaining the skills of scientific and creative thinking.

1.5. The Five Cycle Learning Circle

The learning cycle was first formed as a teaching strategy and consisted of three stages (3E's) namely: Discovery, reaching for the concept and application. With the development of the objectives of teaching science, Karplus (1974) introduced some amendments where they emerge as a part of a project to develop science in the primary stage (Information Service of school catalogue) which was introduced by California university (USA) and the cycle consisted of four stages (4E's), namely:

- The stage of discovery;
- The stage of explanation;
- The stage of elaboration
- The evaluation stage [25].

Moreover, the team for the biological Science Curriculum study (BSCS) that was chaired by Bybee [17] formed a constructive model titled: the five cycle circle. These stages are:

- Engagement;
- Exploration;
- Explanation
- Elaboration, and
- Evaluation stage [17].

As for the strategies of the computerized cycle circle, they are the same as the five multi-media stages (pictures, sounds, drawings, and animated drawings). Here is the strategy of the computerized cycle:

1.5.1. The First Stage: Engagement

The purpose of this stage is to attract student's attention and engage them in the learning process through pre-evaluation of the former knowledge. In addition, during this stage, the students link the previous and current learning experiences, prepare the main structure to move towards the next activities, engage the learners through discussion and present video films that are used to uncover the former knowledge which cause the students pose questions in order to reach a stage titled "the state of cognitive balance".

1.5.2. The Second Stage: Exploration

During this stage the teacher guides students to exploration through the provision of instructions that students should follow in order to gather data through direct senses which are related with the concept intended to be learnt.

1.5.3. The Third Stage: Exploration

In this stage, the teacher discusses with the students to know the interpretations they reached. This stage represents the sole and essence of the topic, where students answer a specific question, and the learner practices the thinking and reflection processes to reach for reasonable and logical interpretations.

1.5.4. The Fifth Stage: Evaluation

Here, continuous evaluation is used to insure the learning process, and to encourage the cognitive construction of concepts and scientific skills. This takes place at each stage of the strategies of the computerized learning cycle.

2. Second: Literature Review

Bilgin, Coskun and Aktas, [14] conducted a study that aimed at studying the 5E's in the mental capacities of the forth grade students in the unit of (material). The sample consisted of (160) students from four various branches in a primary school in Turkey. Two branches were randomly chosen as an experiment group (79 students) who learned by the E's 5 and two groups were control groups (81 students) who learned through the traditional method. A test was applied on the two groups by the WAT to measure the students' mental abilities. Data were transformed into mental maps by using content analysis. The results showed that the students of the experimental group were more capable in learning meaningful and more clear and relevant terms than of the control group.

Akbulut, Sahin and Cepni, [11] conducted a study that intended to define the effect of learning methods and various techniques that were implemented through the model of E's 5 on the alternative concepts that consisted of (32) items.

The study was applied on a sample consisted of (48) students as the learning material relied on the 5E's that was supported with various teaching methods and strategies, that was applied on the control group (25 students). As for the control group (23 students), it was taught by the traditional method using the schoolbook.

The results of the study showed that the teaching material prepared for this study was more effective and appropriate for the conceptual structures for the benefit of the experimental group.

On the other hand, Freyzioglu, Ergin and Kockulah, [21] conducted a study that examined the effect of teaching by using the 5E's on the comprehending the concepts for the 7grade students in the units of power and movement.

Instruction was applied on the experimental group according to the 5E's cycle in a primary school in Izmer, Turkey. The students of the experimental group were taught by the 5E's, whereas the control group were taught according to the recommendations of the science and technology curriculum issued by the National Ministry of Education. The students stat for a pre and post tests in the concepts of power and movement.

The results showed that the conceptual mistakes committed by the experimental group students were decreased in a significant statistical way compared with the results of the control group, based on the grades of the test.

Acish and Turgut Yalcin, [10] conducted a study that aimed at evaluating the efficiency of using the E5 in the academic achievement of the students in two units (movement and power). The study used the semi-experimental method on a sample that was consisted of (60) students (30 students in the experimental and 30 in the control group).

The results showed significant statistical difference in the student's academic achievement in the units of movement and power for the benefit of the experimental group that was taught through the 5E's method.

Tural, Akdeniz & Alev, [33] conducted a study that examined the effect of using 5E's in teaching the concepts relating to the weight and the explanation of losing weight

with the ground gravity on (9 students in the scientific stream in the secondary stage. The instruments of the study were limited on a diagnosis test to uncover the concepts and cognition relevant to weight and the remarks' card to examine the performance of the sample during the activities and tasks provided in the model.

The results showed positive effects for the use of 5E's in teaching the concepts relating to weight and in terms of explaining the loss of weight and its relationship with the ground gravity.

Kanyar & Takkaya and Cakiroglu, [24] conducted a study the examined the efficiency of the 5E's in the achievement of the sixth grade students about the concept of the cell and their beliefs relating to the scientific epistemological beliefs. A questionnaire was prepared about the beliefs of the scientific cognition. In addition, a test about the concept of cells that was applied on a sample consisting of (153) students who were distributed on four classes. Two classes were assigned randomly as experimental and control groups. The experimental groups receive instruction using the 5E's, whereas the control groups were taught by the traditional strategy.

The results showed significant statistical effects for the above said treatment in the students' achievement about the concept of cells and in developing their scientific epistemological beliefs relevant to the scientific knowledge for the benefit of the instruction in accordance with the 5E's strategy.

Campbell, [18] conducted a study that aimed at examining the effect of using the 5E's in providing (22) students of the primary stage the concepts of power and movement and correcting their alternative beliefs relevant to this topic. An achievement test on knowledge about the units of power and movement was applied, as well as a test for the alternative beliefs and a questionnaire for learning the concepts of science. Analysis of the results was based on the work sheets relevant for science lab and the personal interviews with the participants. The results showed efficiency for using the 5E's model in providing the fifth grade students with the concepts of power, movement and correcting their alternative beliefs.

Catalina, [19] examined the effect of the 5E's on the achievement of the 7th grade students for the concepts of development in biology course and their attitudes towards it compared with traditional strategy. The sample consisted of (160) 7th grade students in a preparatory school in Spain.

The results showed significant statistical difference between the control and experimental groups in the students' achievement in terms of the concepts of development included in biology and their attitudes towards it, but for the benefit of the experimental group attributed to the teaching strategy.

3. Method and Procedures

3.1. Sample of the Study

The sample consisted of (48) male and female students of the 4th grade in the Islamic Educational College Schools which apply the Scholastic Aptitude Test (SAT). This school is located in Jabal Amman, Jordan. Two classes were intentionally chosen and one of them was assigned randomly as a control and the other as an experimental group in accordance with the semi- experimental design. Table 1 shows the distribution of the sample in accordance with the teaching strategy (the computerized 5E's cycle, and the traditional 5E's cycle) for both genders (males and females).

Table 1. The distribution of the sample according to the instruction strategy (the computerized 5E's cycle and the traditional 5E's cycle) and gender (males and females)

Group	Gender	Number	Total
Experimental	Males	12	24
	Females	12	
Control	Males	14	24
	Females	10	
Total	**48**		

The researchers chose a branch from the 4th grade primary students which consisted of (25 male and female students) from the same school during the second semester 2015/ 2016 to be a pilot sample. The participants of this group were used to calculate the reliability of the instruments of the study (testing the scientific concepts and the measurement of the scientific thinking skills). In addition, the researchers applied a number of lessons that rely of the computerized 5E's cycle to observe the following:

1. The extent of appropriateness of the lessons, activities and class exercises with the age group (the 4th primary class);
2. The extent of the student's ability to use computer while learning the lessons;
3. Deciding the suitable time to apply the activities of the computerized 5E's strategy;
4. To decide any obstacles and hinders that may arise while implementing the activities and drills of the computerized 5E's cycle as well as the traditional 5E's strategy through controlling the emergent variables.

3.2. The Educational Material

The researchers prepared the educational material of the topics of the scientific content that was taught. It is designed according to the computerized 5E's cycle strategy, taking the American standards in teaching science into account (Massachusetts Standards). The material consisted of (7) lessons as of (14) class lessons. Each lesson required two classes to be implemented. After writing the material, it was presented to a number of supervisors in the Educational Supervision Division who are specialized in teaching science to insure appropriateness for the 4th primary grade.

It worth stating that the computerized educational material was provided by Pearson Company which is in charge for preparing the science curriculum for the 4th primary grade (Interactive Science). A special account for the teacher was established on the company's website (www.myscienceonline.com). This website is protected by a user name and a password, and only the subscriber is allowed to access that site (appendix 8).

In order to present the computerized educational material, the researcher attached a CD with the study that contain some of the computerized lessons which the researcher implemented by using the computerized 5E's cycle.

3.3. Testing the Proficiency of Scientific Concepts

The researchers prepared this test for the purposes of the study: the concepts of two units from (Interactive Science book) for the 4th grade were decided (Matter & Electricity and Magnetism) and extracted the scientific concepts stated in the two units based on suggestions and standards included in the academic curriculum of the American program as well as the developmental and age features of the students of this age. The test included some drawings and colored pictures. The following concepts were taken into account:

(Properties, matter, phase of matter, mass, density, volume, gravity, chemical change, physical change, electric current, circuits, series circuits, parallel circuits, insulator, conductor, resistor, energy, energy transformation, incandescent, light bulb, fluorescent light bulb, magnetic poles, magnetism, electromagnet and generator).

3.4. Content Validity

A test for gaining the scientific concepts mentioned in the two units (matter, electricity and magnetism) in accordance with the table of specifications as stated in Table 2 as follows.

The test, in its primary form consisted of (30 items) with four alternatives, one of them is correct. To insure the validity of the content, the test – in its primary form- was presented to (17) referees and experts who are specialized in the teaching methods of science for the primary stage (supervisors, coordinators and teachers) in the Islamic Educational College Schools and other schools as well as a number of professors at Jordan University. Based on the remarks and recommendations of the referees, the test was amended in such a way that is appropriate with the students of this age and their development features. Accordingly, (5) items were amended and (6) items were deleted so that the final form of the test consisted of (24) item (multiple choice) with four choices for each item.

3.5. Test Reliability

Test reliability was calculated by Test- Retest, as the test was applied on a pilot sample (25 male and female students), and was re-applied after two weeks on the same sample to calculate the coefficient factor between the results of the two applications, with a value of (0,82). This coefficient is accepted and satisfies the purposes of the study.

3.6. Difficulty and Discrimination Coefficients

The psychometric features of the test items were studies, then the coefficients of difficulty and discrimination for each item were calculated.

Table 2. The scientific concepts mentioned in the two units (matter, electricity and magnetism)

Level of knowledge- content	Understanding & comprehension	Application	Meta thinking levels	Total of questions	Percentage %
Material	9, 7, 2, 1	13, 12,3	8,11	9	37,5
Electricity and magnetism	4,5,14,17,18,19,22	6,10,15,17,20	21,23,24	15	62,5
Total	11	8	5	24	
Percentage	45,8 %	33,4 %	20,8 %		100 %

Table 3. Difficulty and discrimination coefficients for the items of the scientific concepts

Item No.	Difficulty Coefficient	Discrimination Coefficient	Item No.	Difficulty Coefficient	Discrimination Coefficient
1	0.50	0.33	13	0.50	0.45
2	0.50	0.57	14	0.50	0.34
3	0.57	0.63	15	0.73	0.30
4	0.29	0.42	16	0.40	0.31
5	0.33	0.51	17	0.41	0.36
6	0.32	0.32	18	0.31	0.55
7	0.43	0.33	19	0.57	0.41
8	0.53	0.63	20	0.40	0.34
9	0.40	0.35	21	0.32	0.42
10	0.78	0.33	22	0.43	0.51
11	0.33	0.38	23	0.30	0.30
12	0.47	0.45	24	0.32	0.31

From the above Table 3, it is clear that the difficulty coefficients for the items ranged between (0.29- 0.78) which accepted for the purposes of this study. In addition, the discrimination coefficients ranged between (0.30- 0.63) as all of them were higher than (0.3). This shows that all of them are accepted for the purposes of this study.

3.7. Test Correction

The test was corrected electronically after the students answered the test (ProProfs/Quiz Maker). This program is used to facilitate the task of conducting and correcting the test and to extract the results. The results were analyzed by using SPSS (appendix 5).

3.8. Procedure of the study

1. Review a number of studies and researches that are relevant with gaining the scientific concepts.
2. Re-structure the proposed lessons in light of the computerized 5E's and present them to a number of referees to have their opinions and thereafter make the necessary amendments based on their remarks and suggestions.
3. Choosing the participants intentionally and assigning them randomly into experimental and control groups.
4. Apply the computerized 5E's on the experimental group and apply the traditional 5E's cycle strategy on the control groups by the same researchers.
5. Apply the test of gaining the scientific concepts on both groups, prior and after applying the experiment by the researchers.
6. Gather and process data by using SPSS and extracting and explaining the results.
7. Propose some recommendations and suggestions in light of the results of the study.

3.9. Design and Statistical Processing

The researchers used the semi-experimental design, as it was applied on two groups (and experimental and a control group) as per the following plan:

EG: O1O2 X1 O1O2 (Experimental Group)
CG: O1O2 X2 O1O2 (Control Group).

3.10. Statistical Treatment

After completing the experimental processing and for the purposes of the statistical processing, the questions of the study were answered, then the researchers tested the (Zero) hypothesis using the descriptive statistics (mean and SD) as well as the explanatory statistics by applying ANCOVA to know the effect of using the computerized 5 E strategy compared with the traditional (non-computerized) strategy in the dependent variables, namely: gaining the scientific concepts and the skills of scientific thinking.

4. Results of the Study

To test the two (zero) hypothesis which state:

First hypothesis: there are no significant statistical differences at (a = 0.05) in gaining the scientific concepts by the 4th grade students, which are attributed to the teaching strategy (the computerized 5E's and the traditional cycle strategy).

The second hypothesis: there are no significant statistical differences at (a = 0.05) in gaining the scientific concepts by the 4th grade students, which are attributed to the interaction between the teaching strategy (the computerized 5E and the traditional cycle strategy) and gender (male, female).

Means and standard deviations for the grades of the experimental and control groups on the pre and post test of the scientific concepts. In addition, ANCOVA (2 X 2) was used to insure the significance of the differences between the means of the performance for the experimental group (which was taught by (the computerized E5) and the control group that was taught by the traditional 5 cycle. Table 4 shows a summary of the descriptive statistics for the participants of the sample according to the teaching strategy and gender (male, female) variables.

From Table 4, we notice virtual difference between the means of the two groups on the test of the scientific concepts (the pre and post test). The means of one of the experimental group on the post test was (19.67) with a standard deviation (2.63), whereas the means of one of the control group on the post test was (16.40) with a standard deviation (3.17). However, the means of the two groups on the pretest was (13.38) and (17,75) sequentially. Which means that there is a significant difference. And to know whether the differences between the two groups are statistically significant, the ANCOVA (2X2) analysis was implemented (Table 5).

Table 4. Means and standard deviations of the means of student performance on the test of gaining scientific concepts in the pre and post measurements according to the teaching strategy (the computerized 5E's and the traditional cycle strategy) and gender (males, females)

		The pre-test for gaining of scientific concepts		The post-test for gaining of scientific concepts	
Group	**Gender**	**Means**	**SD**	**Means**	**SD**
Experimental	**Male**	13.67	3.75	20.00	2.89
	Female	13.88	3,57	19.67	2.63
Control	**Male**	12.36	3.84	15.43	3.57
	Female	13.60	2.99	16.40	3.17
Total	**Male**	12.96	3.49	15.83	3,37
	Female	13.86	3.23	18.00	3.10
Total		13.38	3.53	17.75	3.56

Table 5. Results of ANCOVA (2 X 2) for the significance of the differences in gaining the scientific concepts between the two groups and gender (males, females)

Variation source	Total of squares	Freedom degrees	Means of the squares	F	Sig. level	ITA Total square
The pretest for gaining the scientific concepts	353.39	1	353.39	257.08	0.000	0.592
Teaching strategy	107.68	1	107.68	78.34	0.000	0.1804
Gender	2.97	1	2,97	2.16	0.149	0.005
Teaching strategy (gender)	2.85	1	2.85	2.07	0.157	0.05
Error	59.11	43	1.38			
Amended total	597.00	47				

From Table 5 above, the results show significant statistical differences between the means of performance of the two groups in gaining the scientific concepts. F value was (78.34) which is statistically significant at (a = 0.05). therefore, the (Zero) hypothesis will be rejected for the benefit of the alternative one stating that there is significant statistical difference between the means of the two groups in learning the scientific concepts. Which means that there is a positive effect on scientific concepts. To decide for whose benefit, the difference was, the apposing amended means and SD were extracted. Table 6 shows those results.

Table 6. The amended means of the students' performance on the test of gaining the scientific concepts according to the teaching strategy (the computerized 5E's and the traditional cycle) and gender (males, females) variables

Group	Gender	Amended means	SD
Experimental	Male	19.77	0.34
	Female	18.77	0.34
Control	Male	16.24	0.32
	Female	16.22	0.37
Total		**16.23**	**0.24**

Table 6 shows that such differences were for the benefit of the experimental group as the amended means of its performance was (19.77). the value of the amended means for the control group was (16.23) which indicate that teaching by using the computerized 5E's strategy was more efficient that teaching by the traditional 5E's cycle strategy in teaching the scientific concepts for the 4th grade primary students.

From the results shown in Table 6 it is clear that there is no significant statistical difference in learning the scientific concepts which is attributed to the interaction between the teaching strategy and gender, where F value was (2.07) which is not statistically significant at (a = 0.05). this indicates to confirming the (Zero) hypothesis that state: there are not significant statistical difference in learning the scientific concepts by the 4th grade students which can be attributed to the teaching strategy and gender. This proves that the computerized 5E's strategy in gaining the scientific concepts is similar for both males and females.

5. Discussing of the Results and Recommendations

The first zero hypothesis stated that: there are no significant statistical differences at (a = 0.05) in gaining the scientific concepts by the 4th grade students which are attributed to the teaching strategy (the computerized 5E's and the traditional 5E's cycle).

The results showed significant statistical differences between the means of the students' grades on the test of gaining the scientific concepts which is attributed to the teaching strategy, for the benefit of the experimental group who were taught by the computerized 5E's strategy, compared with the control group who learned by the traditional 5E's strategy.

This means to reject the first zero hypothesis which stated that there is no significant statistical difference in the performance on the test of scientific concepts that was attributed to the teaching strategy. In addition, the results show that the computerized 5E's strategy was efficient in teaching the 4th grade students the scientific concepts more than when using the traditional strategy and with a larger size of effect.

This result can be attributed to factors relating to the nature of the computerized 5E's strategy including:

- The logical and interesting sequence in presenting the educational material from (easy to the difficult and from the simple to the compound) with the variation in the continuous evaluation methods, prompt feedback to encourage the students continue gaining and learning the scientific concepts.
- Interaction between the computerized 5E's strategy and the learners, may decrease boredom and help the students continue learning for a longer period and thus learn more scientific concepts.
- The constructive learning and the computerized 5E's strategy are two active processes, where scientific knowledge is included in the students' knowledge (this is according to the call of Ozobel regarding the need to organize the sequential presentation of the material so that the student will play an active role in gaining and including data within his knowledge.
- Provide a safe class environment through (Dry Lab) or (Virtual Labs) that allow children gain the scientific concepts, practice research, problem solving and make decisions.

The second zero hypothesis stated: "there are no significant statistical differences at (a = 0.05) in gaining the scientific concepts which are attributed to the interaction between the teaching strategy (the computerized 5E's strategy and the traditional 5E's cycle) and gender (males, females).

The results of the study showed no significant statistical differences between the means of the students' grades on the test of gaining the scientific concepts attributed to the

interaction between the teaching strategy (the computerized 5E's strategy) and the traditional 5E's cycle strategy) and gender (males, females). This indicates to the efficiency of the computerized 5E's strategy in helping the students gain the scientific concepts regardless of their gender (males, females) since teachers are not biased for one gender on the expense of the other. The reasons might be due to the importance of justice and equality between males and females in the teaching process.

5.1. Recommendations

1. Encouraging science teacher to adopt the strategy of the computerized 5E's in teaching science for the students of the lower primary stage, since it helps the 4th grade students to gain the scientific concepts.
2. Train science teachers prior and while in service to use the constructive cognitive learning strategies such as the computerized 5E's.
3. Employ the computerized 5E's when reviewing the curriculum and teaching methods for the lower primary stage and for the 4th grade students in particular.
4. Conduct similar studies with the use of other variables such as measuring the effect of the computerized 5E's strategy in gaining other scientific concepts and thinking skills such as creative and critical thinking skills.

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