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The Effect of Using Active Learning Model on Fourth Year Physics Students' Achievement in the Subjects "Teaching Aids" and "Development of Critical Thinking"

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Abstract: This research aims at identifying the effect of using Active Learning on the achievement of 4th year Physics students in "Teaching Aids" and "Development of Critical Thinking". To bring about these aims, two null hypotheses and 5 secondary hypotheses that follow the second main hypothesis have been set. To validate the hypotheses, a sample (71) male and female 4th year Physics students at the College of Education had been selected and divided into two main groups, namely the experimental group and the control groups with (35) and (36) students in both groups respectively. A process of equivalence was done for both research groups in terms of the variables (Intelligence, Previous Year Achievement in Physics, Age, and Critical Thinking). The experimental group was taught according to the Active Learning Model, while the traditional (ordinary method has been adopted in teaching the control group.The researcher prepared the basic requirements of the research represented by identifying the teaching material and the behavioral objectives behind teaching it. Also lesson plans for teaching both the experimental and the control groups have been set according to the Model of Active Learning and the Ordinary Method, side by side with the provision of the teaching aids and laboratory instrument for applying the experiment.

Keywords: Education development, Education methods, Education methods of physics

Introduction

The research required the availability of two tools. The first was an achievement test in the subject "Teaching Aids" and the researcher prepared it. This comprised of (45) items of the types matching, multiple choice questions and filling in the blanks. The research got both validity and] reliability. Also the Level of Difficulty and Distinction Powers were found for all items of the questionnaire; all of which were within the accepted range of difficulty and distinction. Added to that, the activity of wrong substitutes of the items of Multiple Choice.

The second instrument was the Test of Critical Thinking originally prepared by Al-?alwani (1999). The final version of the test comprised of (75) items distributed among 5 areas to measure the critical mental abilities represented by the skills of inference, evaluating pretexts, identifying assumptions, deduction and interpretation. The researcher found out its validity and reliability.

The experiment was applied from the beginning of the first term during the academic year (2017-2018). The pretest for critical thinking was conducted on the sample of students on (18/10/2017) and the experiment started on the (19/10/2017) for a while studying terms with 3 hours per week so that the total number of lectures came to be (27) hours for each group. The experiment ended after the application of the two instruments (Achievement Test and Critical Thinking Posttest) on (24/10/2017).
The statistical analysis of the collected data by means of the T-test for two independent samples came up with the following:

1. There is a significant difference between the achievement means of the two research groups in "Teaching Aids" in favour of the experimental group.

2. There is a significant difference between the means of skill development (inference, deduction, interpretation, and critical thinking a whole) for both research groups in favour of the experimental group.

In the light of the findings of the research, the researcher has come up with a number of conclusions, namely the effectiveness of the Model of Active Learning on the Achievement of 4th year Physics students at the Dept. of Physics in the subjects "Teaching Aids" and "Critical Thinking Development" by the Ordinary Method. The researcher recommended running a training course for male and female teachers of Physics with focus on the use of modern models and strategies in teaching, especially the Model of Active Learning.He also recommended that committees for compiling books of physics should include skill and mental activities that motivate students and enhance their abilities and reinforce their thinking abilities at large and critical thinking inparticular. Finally, the researcher has put forward some suggested topics for future researches.

Problem of the Research

Physics, compared to other sciences, is suffers from misunderstanding, weakness of positive and constructive communication between it and students on one hand, and it and teachers of physics on the other hand. Based on the work of one of the researchers in Physics laboratories, College of Education other/ Dept. of Physics and through the researcher' acquaintance with the researchers and studies related to the teaching of Physics and the difficulties encountered, and also through their repeated visits to many preparatory and secondary schools and eliciting the opinions of many teachers of the subject and others concerned, the researchers found that the difficulty of understanding and learning this subject and the students low achievement in it at large and that of 4^{th} year students in particular are due to many reasons identified by local and international studies and researches. Some of the reasons are related to the methods adopted in teaching Physics, some to students and still some others to teachers. Yet the most prominent reasons remain to be the traditional methods adopted in teaching the subject which had led to the low level of both knowledge and achievement side by side with the limited ability of sound thinking; all of which are highlighted by many studies such as those by Hammash (2004), Al-Khafaji (2008) and (2010).

As such, we can notice the increasing attention to teach this discipline through the educational institutions, and many educational studies and researches have been conducted so as to arrive at a level of understanding and recognition on the part of the learners (Zeghrib, 199: 133). Added to that, the continuous the adoption of the traditional teaching methods has also led to a vivid decrease in the level of students' thinking in general and their critical thinking in particular.

In this respect, Al-harbi points out that the development of students' thinking abilities requires more planning based on thinking of all available alternatives for more utilization and development in the different domains of life. This cannot be available unless the programmes that work to develop the different thinking abilities and skills are adopted. This requires the use of teaching methods and strategies that ally with those programmers so as to activate it and make use of students' latent abilities. The adoption of the traditional teaching methods can negatively affect students' thinking abilities an and skills and create much difficulty in finding solutions for the future problems (Alzarnoofi, 2007: 2).
Since the process of developing students' skills at large and their critical thinking in physics is within the teacher's task through the setting of enhanced learning situations to teach critical thinking. Yet the state of teaching in its traditional form in our educational institutions asserts the existence of a low level of thinking by students in all studying stages and in all domains at large and critical thinking in particular. This has been emphasized by Alkhafaji and AlObaidi (2002), Ameen (2003) and Kerkukli (2008).

There is a possibility to develop students' critical thinking abilities and skills through active learning which feeds the skills of identification and analysis and in turn enable students to develop their self-dependence and not through passive listening (Ibrahim, 2005: 375).

In the light of what has been stated, the researcher has investigated and looked for what can contribute to the solution of the problems pertinent to the teaching of the subject physics (Teaching Aids), the lessening of the difficulties of learning it and limiting their attention to the methods and styles of teaching physics as he thinks that both teaching methods and teaching styles represent one of the effective means to increase achievement and develop critical thinking in this academic subject.

Teaching methods represent one of the effective means to bring about the required changes in the learner's personality and his/her way of thinking. As such, the researcher referred to a developed teaching model that is flexible and suitable to the teaching situation on one hand and their students' learning needs on the other hand. The choice was that of Active Learning Model that contributes to the achievement of a way of teaching that is more effective, removal of learning activities and the promotion of students achievement level and that of their critical thinking in physics. This is due to the fact that this model is a modern one that fits the development arrived at by physics. Added to that, the model has stages where the mental, skills and affective aspects overlap and are enhanced in a way that makes the student the focus of the learning process.

Based on what has been so far stated, the researchers has identified the problem of the research by giving answer to the following question:

What is the effect of the Model of Active Learning on 4th year physics students' achievement in "Teaching Aids" and on the development of their critical thinking?

Value of the Research

What distinguishes the stage we live are the fast and sudden changes. Every day there is more incoming scientific knowledge side by side with more technological applications; all of which has contributed to the solution of the problem that man faces everywhere. It is also affected by their direct and indirect results in the different aspects of his/her life.

Undoubtedly such changes and academic developments affect the teaching process and the present teaching systems have to face this gigantic amount of knowledge, facts and information and has to reconsider times and times the syllabuses, methods of teaching, teaching aids, measurement style and academic activities with an integrated, comprehensive and continuous framework that qualify it to encounter the new and the developed in this changing world (Mazin, 2007: 11).

This requires the doing of basic changesin thestyles and methods of teaching so as to help students acquire an amount of knowledge, skills and attitudes related to the scientific issues and matters and also an amount of the required critical and scientific thinking. Of the disciplines that are related directly to man and his life circumstances is the science of physics which aims at helping man to understand the surrounding natural phenomena and increase his ability to subject them to measurement and estimation and then the man's ability to take benefit from them (AlQuraishi, 2000: 3).

The main reason behind the attention paid to the modern teaching methods is students' learning-teaching needs and the styles used in teaching them and which may be generally inactive. If we can provide beneficial teaching models that may give a chance to teachers to develop different aspectsin their students such as the social, psychological and ethical aspects (Qatami and Qatami, 1998: 12).

There have been several attempts to use and innovate teaching models and strategies which can deal with the explosion in knowledge in physics in terms of ability to organize the amount of concepts, information, relations, theories and roles that the students acquire during studying in such a way that achieves the characteristics of integration, correlation and function. By then the student can use that knowledge to solve the problems he will encounter in his future life.

Among the modern models used in teaching sciences at large and physics in particular is that of (Active Learning) which is based on the constructivist theory. The model was presented by Welly and was then subjected to experimentation on a number of students in the subject of Science, especially the topic "Electricity" to make sure through it that learners' practicing of mental processes according to a strategy (prediction, observation, interpretation) may can contribute to the promotion of the level of their achievement and participation in the classroom, increase cooperation between them and develop their ability to think.

The specialty of the Active Learning Model lies in accommodating basic mental skills that can be developed for learners in the various studying stages and in the subjects that have a link between practical and theoretical sides especially in the science syllabiincluding physics (Teaching Aids).

Prediction is one of the mental skills that subsumes learners' ability to use their previous information or expertise to predict a phenomenon to be studied or an event in the future. This is done in the light of the

available information or the partial events pertinent to the phenomenon or the event or the subject of studying. While observation means the intentional and critical attention to phenomena or events so as to uncover the reasons that led to its emergence through the use of the senses (Abdul-Hadi and Ayyad, 2009: 152-153).

Interpretation is a mental skill that aims at adding meaning to the life experiences and deduce a meaning for them. When we put forward an interpretationof an expertise we are but explaining the meaning that is derived from it. And when we ask about the way of arriving at a certain meaning we are but putting forward details that support our interpretation of that expertise (Garwan, 2013: 167).

Since Active Learning Model is a relatively modern model, it has been limitedly tackled. For instance, at the local level, Al-Daini (2001) states that the Active Learning Model has a positive effect on students' achievement in Sciences. Al-Khafaji and Al-Obaidi (2002) showed that the Active Learning Model was effective in developing university students' critical thinking. Also, Al-Obaidi Study (2004) demonstrated the supremacy of the students in the experimental group that was taught according to the Active Learning Method over those in the Control Group which was taught by the traditional method in "Science" of fourth year secondary level. Al-Rubai'i (2007) also states that the girls in the experimental group that was taught by the Active Learning Method achieved better in the field of practical skills than their counterparts in the Control Group that was taught by the traditional method. While Al-Haidari's (2007) study showed that the Active Learning Model has a positive effect on the achievement of first intermediate students in "General Sciences", and that the model was effective in creating mental skills on the part of the pupils.

All this has encouraged the researcher to adopt this model in his research especially if we know that there is no study that has tackled the effect of this model on both achievement and thinking together in "Teaching Aids" taught to fourth year students/ Dept. of Physics.

As such, the use of this model in teaching should be related to the achievements of the objectives behind teaching "sciences"in generaland those behind teaching Physics in particular. Among the important objectives which should be there behind teaching Physics through its varied strategies and models is the development of learners' thinking including all its critical, innovational and scientific dimensions.

Thinking is of different types the most important of which is critical thinking whose teaching and the learning of its skills have been a prime purpose behind the educational policies all over the world and a main objective that all syllabi intend to achieve due to the positive outcomes it has brought about. It has also been proved to have its effects in the life of the individual and the society.

The process of thinking occupies an important status in the educational work and the studying syllabi in all the advanced states worldwide aim at enabling the learner to learn the methods of thinking so as to enable him to adapt with the society wherein he lives and to solve the problems that he encounters in life whether inside the school or outside it. All researchers have proved that failure in developing thinking and its skills represents a main reason behind the emergence of learning difficulties and failure in studying (Ibrahim, 2014: 299).

The main objective behind teaching and learning critical thinking is to improve students' critical thinking which enables them to succeed in all the aspects of their life. It also encourages the spirit of enquiring, researching and questioning, and not to accept facts without investigating or exploring and in such a way that leads to widen students' knowledge horizons, and urges them to set out to wider academic avenues which aims at enriching their knowledge construction and increasing their qualitative learning (Abu Jado and Mohammad, 2012: 225).

Critical thinking as an objective of contemporary education should be developed and its skills should be taught and trained on methods according to suitable teaching methods in spite of the growth and development by the members of the society so as to build and an objective personality and active and participating citizenship in the free society (Mcfarland, 1985: 277).

Fath-Allah (2009) states that critical thinking can be developed in teaching sciences especially Physics by directing students' attention to identify the problems to be solved, to analyze them, to interpret the results, and ask students to carry out activities that require attention and the defiance of mental abilities. And also through directing students' attention to think about their way of thinking and directing it to arrive at the best solutions and to put aside the unsuitable solutions (Fath-Allah, 2009: 91).

It is worthy to note that there are Arabic and foreign studies that deal with critical thinking and developing skills through the use of different teaching models and methods and also its relation with some other variables.

The researcher has seen many studies and taken benefit from them in crystallizing the major points of his research and its orientation. Of these studies are: Kjos and Long (1994) which used the method of problem solving to improve critical thinking, and Al-Alwani's study (1999) which used Klausmeir's strategy and the strategy of contrastive events to learn the concepts of Physics and to develop critical thinking of "Physics". Al-min's study (2003) used two patterns of problem solving to develop the concepts of Physics and critical thinking. Al-Obaidi's study (2005) aimed at identifying students' critical thinking skills. Karkukli's study (2008) used a suggested strategy in teaching mathematics to develop critical thinking. Fath-Allah's study (2009) used thinking maps based on merging to develop achievement and orientation towards cooperative work and critical thinking in "Sciences". Al-Hadeedi's study used the model of knowledge teaching to acquire mathematical concepts and develop critical thinking. There are many other studies. In the light of what has been so far stated, the value of the research can be summarized in the following points:

1. The research tallies with the new orientations in selecting a teaching model and accommodating it in the process of teaching which will duly contribute to the promotion of students' knowledge level and the development of their thinking al large and critical learning in particular.
2. The research derives its value from the importance of critical thinking as it has been a modern urgent need and an essential educational objectives of teaching "Sciences'.
3. It is expected that teaching according to the Active Learning Model will contribute to students' acquisition of a number of basic skills such as telling opinion through prediction and enhancing practical abilities through observation and enhancing mental abilities through explanation in addition to cooperation and taking over responsibility.

The Aim of the Research

The current research aims at identifying the effect of using Active Learning Model on the achievement of 4th year Physics students in the subject "Teaching Aids" and the development of their critical thinking.

The Hypotheses

To bring about the aim of the research, the following two hypotheses have been formulated:

Hypothesis No.1:

There is no significant difference between the mean of the scores of the students in the experimental group which has been taught according to the Active Learning Model and that of the scores of the students in the control group which has been taught according to the traditional model in the achievement test of the subject "Teaching Aids".

Hypothesis No.2:

There is no significant difference between the mean of the scores of the students in the experimental group which has been taught according to the Active Learning Model and that of the scores of the students in the control group which has been taught according to the traditional model in the development of critical thinking.

Limits of the Research

The present research is limited to
1. Fourth Year student/ Dept. of Physics, Open Educational College during the academic year 2015-2016.
2. First studying semester of the academic year 2015-2016.
3. The chapters: first, second and third of the Laboratory Teaching Manual (Teaching Aids) Fourth Year student/ Dept. of Physics during the academic year 2015-2016.

Definition of Basic Terms

First: Model

- Mayer (1995: 687)defines a model as the techniques and methods based on certain learning theories that are designed to arrive at selected teaching objectives.

- Qatami and Qatami (1998: 36) define a model as the strategies used by teachers in the teaching situation so as to achieve teaching outcomes by students according to suppositions on which the Mode is based and within which the role of teacher and students and the style of presentation are identified.

- Al-Zaghlool (2002: 319)states that a model is a full plan and formulation that subsumes the design of a certain content or subject, performing and orienting the process of learning it inside the classroom and evaluating it.

Second: Active Learning Model

- **Welly (1994: 4)** defines Active Learning Model as a teaching model that includes three successive stages: prediction, observation and explanation. It is done by teachers and is worked on within small groups under orientation and counseling on the part of the teacher.

The Operational Definition of Active Learning Model

It is the set of successive procedures required to prepare the teaching plans of the subject "Teaching Aids" for 4th year/ Dept. of Physics according to three mental skills defined in the Active Learning Model, namely prediction, observation and explanation within small cooperative groups.

Third: Achievement

- Good (1973: 7) defines achievement as efficiency in performing a certain skill or a set of acquired knowledge and progress in studying.

- Al-Khaleeli (1997: 6) states that achievement is the result that outlines the students' level and the extent of his progress in learning and what is expected from him to learn.

- Al-Shu'aili and Al-Balooshi (2006: 54) defines achievement as the knowledge, skills and values that the student acquires after going through the teaching experiences and situations that are prepared in advance.

The operational definition of achievement is:

All the knowledge and skills that 4th year students/ Dept. of Physics achieve and the scientific facts, concepts and principles in "Teaching Aids" they acquire due to the preplanned teaching and learning expertise they encounter. Achievement is measured by the score the student gets in the achievement test that is prepared for this purpose.

Fourth: Critical Thinking

It is defined by

- **Paul (1995: 2)** as a unique type of conscious thinking owned by the person who thinks in an organized way and according to clever criteria taking into account methods of thinking and assessing its effect in the light of the objectives.

- Abda (2007: 78) as a series of mental activities and skills carried out by the human's brain when exposed to an irritant received via the senses followed by a process of search for meaning in the different situations.

- Al-Atoom and others (2009: 73) as reflective thinking governed by logic and analysis rules where the individual practices presuppositions, explanation, evaluating discussions and deduction.

- Abo Jado and Mohammed (2012: 231) as personal, evaluative, and reflective thinking that subsumes a set of interrelated knowledge mental processes such as explanation, analysis, evaluation and deduction that aims at examining opinions, beliefs, testimonies, proofs, concepts and claims which are referred to when issuing a judgement or solving a certain problem or making a decision taking into consideration others' viewpoints.

The Operational Definition of Critical Thinking

It is a set of mental skills performed by 4th year students/ Dept. of Physics when exposed to a certain situation or a certain issue of Physics which enable them to judge the things pertinent to a situation or a problem, understanding it, and evaluating it so as to arrive at a suitable solution. These skills include deduction, evaluating pretexts, identifying presupposition, deduction and explanation. It is measured by the score the student gets on the test prepared for that purpose.

Research Procedures

First: Experimental Design

The researcher adopted the experimental design called Equivalent Groups Design with pretest and posttest (Cohen, 2013: 213) as it fits the current research and brings about its aims. This design includes two equivalent groups in a number of variables. The first group, as the experimental group, is taught according to Active Learning Model and the second group, as the control group,is taught by the traditional methods.

Research Population

The research population includes 4th year students at the Open Educational College for the academic year (2015-2016). They are (82) male and female students distributed among 4 groups.

Research Sample

After defining the research population and identifying the studying halls in terms of studying sections. Physics Branch/ Dept. of Sciences/ Open Educational College, 4th year students have been intentionally selected from the research population for the following reasons:
1. The college has Physics laboratories that can be used as fully equipped lecture halls so as to implement the research experiment on the students.
2. The Dept. administration and teachers of Physics in the laboratories showed readiness to cooperate with the researcher and offered the facilities required to conduct the research.
3. The researcher was a member of Dept.'s teaching staff.

Both experimental and control groups were randomly selected. Section (B) was chosen to represent the experimental group which was taught physics according to the Active Learning Method, and section (A) represented the control group material that was taught the same teaching material by the traditional method.

The repeaters in both research groups were statistically excluded due to previous expertise, as outlined in Table (1) below:

Table 1. Number of research sample

Section	Group	Method of Teaching	No. of Students before Exclusion	Number of Repeaters	No. of Students After Exclusion
A	Control	Traditional Method	42	6	36
B	Experimental	Active Learning Model	40	5	35
Total Number of Students			82	11	72

Fourth: Equivalence of Research Groups

For the research to be valid to the level that the difference between the experimental group and the control group can be ascribed to the independent variable and not to other variables or intrusive factors, the researcher conducted a process of equivalence between the research group in variables that can a great effect on the research outcomes, namely (intelligence, previous achievement in General Physics, time age, and Critical Thinking). After calculating the arithmetic means and standard deviations of these variables for both control and experimental groups and then applying T-test for two independent samples, the results are listed in Table (2) below:

Table 2. T-test results for the research groups on the equivalence variable

Variable	**Group**				**Calculated T Value**
	Experimental		**Control**		
	Mean	**SD**	**Mean**	**SD**	
Intelligence	91.8	7.7	90.38	6.525	0.88
Previous Achievement in Physics	61	8.39	59.83	8.443	0.585
Age in Months	222.381	9.342	221.77	9.822	0.268
Previous Critical Thinking	48.4	3.7	47	4.05	1.52

It is clear from Table (2) that the calculated T values for the four equivalence variables are all below the tabulated t values at the adopted significance levels which is (2.000) at the level of Significance (0.05) and the Degree of freedom (69). This means there is no statistically significant difference between the two research groups on these variables. As such, the two groups are equivalent.

Research Requirements

To bring about the aims of the research and validate its hypotheses, the researcher prepared a number of requirements, and as follows:

Identifying the Teaching Material

The teaching material has been identified to include Chapter One, Two and Three of the Prescribed Manual for teaching the subject "Teaching Aids" to 4th year students, Dept. of Physics, and as follows:
- Chapter One: Magnetism.
- Chapter Two: Electricity.
- Chapter Three: Optics.

Formulation of Behavioral Objectives:

Behavioral objectives are an essential basic step in the preparation of any teaching program as they clarify what the learner is supposed to achieve by the end of his/her studying of the scientific content of the program (Al-Khaleeli and Others, 1995: 98).

In the light of the general objectives behind teaching the subject to 4th year students/ Dept. of Physics and depending on the analysis of the teaching materials within the limits if the research, the researcher formulated the behavioral objectives which have been (60) in number according to Bloom's Taxonomy at the levels: Memorization, Understanding, Application and Analysis) respectively. The objectives have been presented to a panel of experts (See Appendix 1) to give their opinion on the formulation of the objectives and to find out the extent of their achievement of the aims behind teaching the subject, the suitability of knowledge levels, and its relation to the teaching material. Some behavioral objectives have been modified in the light of the experts' pinions, and put in their final wording.

Preparation of Teaching Plans

The researcher prepared a set of daily plans to teach both control and experimental groups in the light of the prescribed teaching material and according to some definite teaching steps of the Active Learning Model and the traditional method. A model of teaching plans for each group with the behavioral objectives were presented to a number of experts and specialists in the fields of Physics, education and methods to state their opinions on their fitness and suitability (Appendix 1). In the light of their opinions some modifications were made and they became ready for use. Other teaching plans were prepared in the light of two modified models.

Sixth: Research Tools

Bring about the research aims and verifying its hypotheses required two tools:

First: A pre-test in the subject "Teaching Aids".

Second: A critical thinking test.

Following is clarification of the stages to prepare the two tools:

First: Achievement Test

The current research required preparing an achievement test to measure students' achievement in "Teaching Aids" for both experimental and control groups to identify the effect of Active Learning Model and the traditional method on achievement.

Achievement tests are an organized way to identify students' level in the teaching subject, which is supposed to be learned officially in advance, by giving answers to a sample of questions (items) that represent the content of the teaching subject (Al-Ibadi, 2006: 19).

Accordingly, the researcher prepared an achievement test that goes with the content of the teaching subject and the behavioral objectives that were prepared in advance according to Blooms' Taxonomy in the field of knowledge which includes: memorization, understanding, application and analysis.

A table of properties has been prepared in the light of the behavioral objectives. The number of the items of the test in its initial formulation was (45) items derived from objective tests (Multiple-Choice tests, Matching and Filling in the Blanks). Such tests are usually comprehensive, easily conducted, of low cost, economic in terms of the efforts exerted on correction (Samara and Others, 1989: 65). Concerning the distribution of the test items amongthe four knowledge levels, see Table (3):

Table 3. Distribution of the test items among the four knowledge levels

Knowledge Level	Items No.	Number
Memorization	1, 3, 4, 12, 14, 15, 17, 20, 23, 29, 30, 31, 32, 35, 36, 40, 42	17
Understanding	5, 6, 9, 10, 16, 18, 19, 24, 27, 28, 33, 39, 41, 44, 45	15
Application	7, 8, 11, 22, 26, 34, 38	7
Analysis	2, 13, 21, 25, 37, 43	9

Test Validity

Test validity means that a test measures what it has been set to measure. That is to say, a valid test measures the function it aims to measure and does not measure anything else instead of or added to that (Mulhim, 2000: 272).

To prove test validity, the test in its primary form with a list of behavioral objectives and the prescribed manual of "Teaching Aids" in addition to the table of properties were given to a group of experts and specialists in the fields of Evaluation and Measurement, Methods of teaching Physics and Sciences, and teachers of Physics (Appendix 1). The percentage (80%) and above of agreement has been adopted as a criterion for accepting the item.

In the light of the notes by the group of experts and specialists, all the items got this percentage and more, in addition to the modification made to some items in terms of formulation, content of Physics, and the addition of some diagrams for clarification. As such, both face validity and content validity of the test have been proved.

The Pilot Experiment of the Test:

To approve the psychometric properties of the test items and know the clarity of the instructions as well as calculating the time students needed to answer the test, the test was administered to a pilot sample of (50) male and female 4th year students/ Dept. of Physics/ College of Science. It was evident from the test that the instructions were clear and the time required to answer all the items was (70) minutes; the time the last student needed to leave the test hall. After scoring the answers, the results were statistically analyzed to find out the difficulty factor, the distinction factor, and wrong alternatives activity. In the light of that, the test was put in its final version subsuming three sets of items according to the way they were supposed to be answered. They were:
- The first set includes (10) items of the matching type.
- The second set includes (25) items of the Multiple Choice type.
- The third group includes (10) items of Filling in the Blanks type.

Test Reliability

Reliability means agreement or alignment in results (Marshal, 1972: 104). The reliable test is that which measure a phenomenon with an acceptable level of accuracy (Awda, 1993: 335).Kuder-Richardson -20 Equation has been adopted to measure the reliability of the test as it fits this type of tests (Mulhim, 2000: 265). Reliability coefficient of the test was (0.92). This means that the test was characterized by a high reliability and stability degree and could be depended upon. Accordingly, the final version of the test included three sets of items according to the way to be answered. They were:
- The first set includes (10) items of the matching type.
- The second set includes (25) items of the Multiple Choice type.
- The third group includes (10) items of Filling in the Blanks type.

Second: Critical Thinking Test

Since one of the aims of the research is to identify the effect of Active Learning Model on Developing the critical thinking of 4th year students/ Dept. of Physics, this required the adoption of a test of critical thinking. The researcher got access to a number of studies and tests specifically related to the critical thinking of students at different studying levels. After discussions with some teachers of long expertise and experience in teaching, the two researchers adopted, as a research tool, the test prepared by Al-Alwani (1999) as it serves the objectives of the research and suits the research population. This is so because the items are but situations and questions of physics pertinent to what the student has studied in the subject "Physics" and the scientific experiences he has gone through during the previous period of his studying.

The construction of the test was based on Watson and Glassier's Test on critical thinking which subsumes five areas to measure the critical mental abilities represented by the following skills:
1. Deduction: Includes 5 situations and 18 items.
2. Evaluating Pretexts: Includes 5 situations and 15 items.
3. Identifying Suppositions: Includes 3 situations and 12 items.

4. Induction: Includes 5 situations and 15 items.
5. Explanation: Includes 5 situations and 15 items.
Accordingly, there are 23 situations and 5 items.

Test Validity

To bring about test validity, it was given to a group of experts and specialists in the fields of Evaluation and Measurement, Methods of teaching Physics and educational psychology (Appendix 1). The percentage (80%) and above of agreement has been adopted as a criterion for accepting the item. By so doing, the face validity of the test was proved.

Test Reliability

Kuder-Richardson -20 Equation (K-R- 20) has been adopted to measure the reliability of the test after applying it to a pilot sample of (60) male and female 4th year students/ Dept. of Physics/ College of Science. Reliability coefficient of the test was (0.92). This means that the test was characterized by a high reliability and stability degree. Samara and Others (1989: 120) see that if reliability reaches (0.75), it is regarded a high reliability.

Clarity of Instructions and Calculating the Time of Answering:

From the answers of the pilot sample, it was evident that the test instructions were clear the students. The time spent on answering all the items was (60) minutes, It was the time spent by the last student needed to leave the test hall.

The Final version of the Test

After insuring both validity and reliability, the test of Critical Thinking was ready for implementation in its final form:

Seventh: Correction of research Tools

Both research tools were corrected in the following way:

The Achievement Test

Since the achievement test is an objective test of the types matching, multiple choice and filling in the blanks, the researcher put a key to score the items of the test when the score (1) was given to the correct answer and (0) to the wrong or neglected answer or the one that was marked by more than one alternative. As such, the score of the achievement test ranged from (0) zero to (45) marks.

Critical Thinking Test

The researcher put a key to score the items of the test when the score (1) was given to the correct answer and (0) to the wrong or neglected answer or the one that was marked by more than one alternative. As such, the score of the achievement test ranged from (0) zero to (75) marks.

Eighth: Procedures of the Safety of Experimental Design

The researcher proved the internal and external safety of the experimental design by controlling its effects.

Ninth: Procedures to Implement the Experiment

After choosing the research sample and dividing it into two equivalent groups (Experimental and Control) on a number of variables in addition to the preparation of the two tools and the set of teaching programmers according to the Active Learning Model and the Traditional method and insuring both internal and external safety in terms of a number of variables, the researcher started executing the experiment from its first day. They adopted the steps and procedures to carry out the class for both experimental and the control groups, and as follows:

The Experimental Group

The students in this group were taught according to the Active Learning Model, and as follows:
At the beginning, the researcher distributed the students inside the classroom or the laboratory in the form of randomly selected groups of (4-5) students of heterogeneous achievement. Then for each group, the required tools for work and an agenda that includes certain instructions and questions were prepared.

After that, a short introduction about the prescribed teaching subject and some motivating questions were posed in front of the students either orally or written on the board. Finally, the teacher moved to the presentation of the teaching material according to the Active Learning Model which includes the following three stages (previously explained):
1. Prediction.
2. Observation
3. Explanation.

The Control Group

Students in this group were taught according to the traditional method and as follows:
1. Writing the main subtopics of the prescribed teaching subject on the board.
2. Giving an introduction to the new lesson by relating it to the previous lesson by posing a set of review questions or based on direct explanation.
3. Explaining the teaching material through examples, definitions, or diagrams available in the manual and focusing on some important and prominent points with some questions directed to students and doing some simple experiments in front of them if required.
4. Finally, the lesson is summarized in the form of points on the board. Students are asked to jot them down in their notebooks. Finally, students are asked some evaluative questions.

Tenth: Statistical Means

The following statistical means have been used:
1. Level of Items Difficulty to find out the level of the difficulty of the achievement test items (Al-Abai, 2006: 96).
2. Distinctive Power of Items to find out the distinctive power of the achievement test items(Ibrahim and Others, 1989: 78).
3. The Effectiveness of Wrong Alternatives to find out the wrong alternatives of the achievement test items from the Multiple Choice type (Al-Dhahir and Others, 1999: 91).
4. Kuder-Richardson-20 to find out the reliability of both achievement and critical thinking tests (Ferguson, 1981: 243).
5. T-Test for two independent samples to bring about equivalence between the two research groups (Al-Baldawi 2004: 227).

Discussion of Results

First: Results Related to the First Hypothesis which states:

"There is no significant difference between the mean of the experimental group students' scores who are taught according to the Active Learning Method and that of the control group students who are taught according to the traditional method in terms of their achievement in the subject "Teaching Aids".
To validate this hypothesis, t-test for two independent samples has been used. After analyzing the data, the results demonstrated in Table (4) below have been arrived at:

Table (4) T-test results of the mean scores of the experimental and control groups on the achievement test

Group	No.	Arithmetic Mean	Variance	Degree of Freedom	Calculated t-test
Experimental	**35**	**34.8**	**18.517**	**69**	**4.49***
Control	**36**	**29.8**	**25.418**		

- **p<0.001**

It is evident from table (4) that the calculated t value is (4.49). comparing this with the tabulated t value (2, 2.65, 3.44) at the levels of significance (0.05, 0.01, 0.001) successively and 69 Degree of Freedom, the calculated t value is larger than the tabulated t value at the lowest level of significance, that is (0.001).

As such, the first null hypothesis is rejected this indicates that there is a statistically significant differencebetween the two groups in achievement in favour of the experimental group which was taught according to the Active Learning Model. This result is in agreement with that of Welly (1994), Al-Rubai'i (2007), and Al-Haidari (2007).

The researcher ascribe that to the technique that characterizes the Active Learning Model according to its three stages (Prediction, observation and explanation) which makes students compete among themselves in their groups and be eager to know the results of what they have predicted through their observation of what was going on while they were doing the practical experiments and activities pertinent to the teaching subject. The students' enjoyment of competition and eagerness to learn reach their climax when students explain what they observed practically by relating it to the situation they are living and then recognizing the meaning, i.e. for them, learning becomes meaningful. As a result, the student becomes more interactive with the requirements of the teaching subject, the way the class is going on, and understands his teacher better, and assimilates the teaching method represented by the Active Learning Model.

Added to that, the independence of each step of this model by itself, its clarity and correlation with each other lead to the integration of the knowledge image for the students in the experimental group. This is represented by their ability to solve problems in physics in a scientific way at the level of the syllabus or outside it,And it been positively reflected on their achievement in "Teaching Aids". Also, the integration that takes place in this model in both practical and theoretical parts, the fixedness of the things observed through experimenting and jotting down and explaining the results arrived at, all enhance the retention of information and the correction of the wrong concepts in students' minds as it is due to understanding and assimilation and not mere superficial knowledge.

Second: Results Related to the Second Hypothesis

The second hypothesis states:

"There is no significant difference between the mean of the experimental group students' scores who are taught according to the Active Learning Method and that of the control group students who are taught according to the traditional method in terms of the development of critical thinking".

To validate this hypothesis, t-test for two independent samples has been used. After analyzing the data, the results demonstrated in Table (5) below have been arrived at:

Table (5) T-test results of the mean scores of the experimental and control groups on the critical thinking test

Group	No.	Arithmetic Mean	Variance	Degree of Freedom	Calculated t-test
Experimental	**35**	**5.57**	**19.878**	**69**	**4.3***
Control	**36**	**0.944**	**12.682**		

- **p<0.001**

It is evident from table (4) that the calculated t value is (4.3). comparing this with the tabulated t value (2, 2.65, 3.44) at the levels of significance (0.05, 0.01, 0.001) successively and 69 Degree of Freedom, the calculated t value is larger than the tabulated t value at the lowest level of significance, that is (0.001), As such, the second null hypothesis is rejected this indicates that there is a statistically significant difference between the two groups in critical thinking in favour of the experimental group which was taught according to the Active Learning Model. This result is in agreement with that of Al-khafaji and Al-Obaidi(2002), Amin (2003), Karkukli (2008), Fath-Allah (2009) and Al-Hadidi(2009).

The researcher ascribe that to the effectiveness of the Active Learning Model according in accommodating several teaching styles to enhance critical thinking skills. Examples of these teaching styles are cooperative learning in groups, side conversations, learning through question raising, brain storming, comparisons, identification of properties and characteristics, inquiring about the available clues to support the occurrence of a certain outcome, thinking of the value of outcomes and critical and careful judgment on results. All of this has helped students to express their ideas, reflecting on and modifying them, which has in turn led to the development of critical thinking in a positive and an ongoing way.

Added to that, the stages of Active Learning Model have aspects that enhance critical thinking skills and the tools that these skills require which are related to the understanding of the phenomena, logical analysis of things and the ability to take decision in a reasonable way far from extreme fanaticism towards other pinions. Prediction, observation and explanation interrelate and participate with the students' critical thinking skillsin such a way that leads to the promotion of the development level of those skills and this type of thinking.

Conclusions, Recommendations and Suggestions

First: Conclusions

In the light of the results arrived at, the researcher conclude that:
1. The effectiveness of the Active Learning Model on 4th year students/ Dept. of Physics achievement in the subject "Teaching Aids" and the development of their critical thinking compared to the traditional method.
2. The possibility of applying the Active Learning Model in teaching the subject "Teaching Aids" to 4th year students/ Dept. of Physics.
3. Dividing students taught according to this model into cooperative groups of definite functions has contributed to their motivation and interaction with the way the class was going on. It has made the class more active and interesting. This has been positively reflected on the outcomes.

Second: Recommendations

In the light of what has been stated, the researcher recommend:
1. Running training courses by the Directorate of Training / The General Directorate of Education for teachers of Physics at the Preparatory Level to train them on using the modern teaching models and strategies including Active Learning Model.
2. The authorities in charge have to prepare a suitable teaching environment and provide the teaching aids and devices needed in teaching physics at the educational institutions so as to facilitate the application of the modern teaching models in general and Active Learning Model in particular as it requires mixing between the practical and theoretical aspects while teaching.
3. The committees in charge of compiling textbooks at the Ministry of Education have to include in the textbooks of Physics mental and skill activities to train students on practicing thinking skills at large and critical thinking in particular.
4. The same committees have to attach a practical manual including the suggested experiments to be carried out, the purposes behind them, and the materials and devices to the physics textbooks so as to train students to do experiments and to increase their living of the practical situation of Physics.

Three: Suggestions

To make the results of the current research more comprehensive and complete, the researcher suggest the following:

1. Carrying out a study similar to the current one on other studying stages and on other teaching subjects.

2. Carrying out a study similar to the current one on schools and other educational institutions.

3. Carrying out a study similar to the current one taking into account other dependent variables such as academic thinking, innovative thinking, motivation, change of conceptions in Physics, Attitudes towards Physics andanalyzingthe Physical meaning.

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