The Effectiveness of Advance Organizer Model on Students' Academic Achievement in Learning, Work and Energy at Adwa College of Teachers' Education

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Abstract: *The purpose of this study was to investigate the effectiveness of the advance organizer model (AOM) on students' academic achievement in learning work and energy. The design of the study was quasi-experimental pretest–post-test nonequivalent control groups. The total population of the study was 139 first year students of three sections in Adwa College of Teacher Education in Tigray Region, Ethiopia. Two sections with equivalent means on the pretest were taken to participate in the study purposely and one section was assigned as the experimental group and the other section was assigned as the control group randomly. The experimental group was taught using the lesson plan based on the AOM, and the control group was taught using the lesson plan based on the conventional teaching method. Pretest and post-test were administered before and after the treatment, respectively. Independent sample t-test was used to analyze the data at the probability level of 0.05. The findings of the study showed that the AOM is more effective than the conventional teaching method with effect size of 0.49. This model is also effective to teach male and female students and achieve objectives namely understanding and application. However, both methods are equally important to teach work and energy under the objective knowledge level*.

Keywords: advance organizer model, quasi experimental, academic achievement, Physics Education

Selected Sub-theme-lifelong learning, learner needs, teacher development, and success in higher education

Introduction

Education is a process, in which teachers, students and curricula are the three major components that make teaching and learning meaningful (Eggen and Kauchak, 2011). Teaching is a process which is planned and organized by the teacher for the purpose of better learning of students by selecting

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appropriate teaching method that fits to the contents of the lesson (Ahmed, 2004). Science and Technology has great contribution for the development of any country. Thus, as Best and James (2003) argued that improving science teaching and learning is a national priority in the educational system of country in question. Since science contains many abstract concepts, students may learn them in different ways. Therefore, so that science teacher should use an appropriate method of teaching for effective teaching to take place (Driver et al., 1994).

As a result, according to Linn and Eylon (2006), science education emerged to solve this particular problem which focuses on studies, how to teach science? And whom to teach science? Whom to teach science? The world is full of experiences that cry out for explanations. Think, for example, of the colors of rainbows and soap bubbles, the vapor trails of high-flying aircraft, the fact that liquid water abruptly changes into solid ice at a certain temperature, the production of lightning and the thunder that follows it in a storm, the beautiful hexagonal symmetry of small snowflakes and energy transformation in hydroelectric power; all these and a limitless list of other phenomena fall within the province of the science of physics. The essence of science in general is the observation and exploration of the world around us with a view to identifying some underlying order or pattern in what we find. And physics is that part of science which deals primarily with the inanimate world (Whitehead, 2011), and which furthermore is concerned with trying to identify the most fundamental and unifying principles.

Physics is one branch of science education in which it also works conducting research on different topics of physics to make the teaching learning process understandable and meaningful. Physics teachers have a unique practice of this subject. As teachers, they have to "engineer" knowledge in order to teach it, i.e. to make it learnable by their students. Usually, they do not directly use the knowledge created by the researcher, but, rather, an intermediate knowledge which has already been reformulated (Solomon, 1985).The purpose of physics teaching in college is to enable students to grasp systematically the basic knowledge of physics needed for further study of modern science and technology and to understand its applications. Physics teaching-learning process provides more possibilities of involving children in such activities as are liked by the students (Linn and Eylon, 2006).

Model of teaching is an exciting and rapidly developing field that holds much promise both as scientific enterprise and means of improving cognitive abilities of the learners. Models of teaching are designed to shape and implement these strategies to help learners to develop their capacity to think clearly and wisely and build social skills and commitment (Githua and Angela, 2008). Models of teaching supports their teaching in the creation of proper environment and various components of teaching are interrelated. According to Joyce and Weil (2004), a teaching model can be considered as a type of blueprint for teaching and it provides structure and direction for teaching.

In this study, the topic work and energy is selected because it is one of the most important topics in physics. However, most of students have difficulty in understanding work and energy from point of view of physics and to their daily life activities. According to the researcher teaching experiences, most of the teachers at Adwa College of teacher Education used only conventional teaching method such as lecture and demonstration in which the students are passive receivers and teachers are sources of knowledge. As a result, the students in the College complain that physics is difficult and physics classrooms are boring which leads them to poor academic performance in physics. This poor achievement students achievement has prompted educational researchers worldwide to continuously identify factors that can account for academic outcomes in the classroom (Goldring and Osborne, 1994).

Different researchers in Ethiopia claim that academic achievement is affected by different factors. For instance, Fekadu (2008) argued that students achievement in physics is affected by the variety of schools, need of students, preparation of curriculum, skill of teacher in class room situation, teaching methods, and administration. Ahmed (2004) also argued that active teaching methods had an influence on students' academic achievement. Furthermore, Aklilu (2010) argued that teaching physics through computer simulation enhances students' academic achievement. Among these, the teaching method has to be given priority due to its frequent impact and direct consequence upon the learners' achievements. In our College, there is no culture of doing research on physics pedagogical methods.

The results of the studies regarding the effectiveness of teaching models vary from situation to situation, that is, in some researchers' findings. AOM is effective while it is ineffective in other findings. Recently, studies have been conducted to evaluate the different dimensions of the AOM. Two investigators, namely, Shihusa and Keraro (2009) conducted the effect of advance organizer model on students' motivation in learning biology and they found that students taught using advance organizers had a higher level of motivation than those taught using conventional teaching methods. However, no attempt has been made in Ethiopia in general and in our College in particular, so far, to analyze the effectiveness of advance organizer model on students' academic achievement in learning physics in general and work and energy in particular. The researcher experience and awareness regarding the methodology of teaching exists in the present College system convinced him that there is a felt need to change the method of physics instruction. Any meaningful attempt to evolve a new strategy of teaching will be a great help and remedy to the present repetitive system of instruction (Lee and Liu, 2010). Obviously, there are various types of teaching methods in the educational system. Each of the methods is used under a suitable situation. Although there is no best method of teaching/learning (Carin, 1997) in the education system, there is a choice of one method over the other due to nature of the learner, nature of the content, and the desired outcomes. As far as comparing the effectiveness of methods is concerned, some educators advocate the self-centered indirect instructions of constructivist approaches such as the guided discovery method (Akinbobola and Afolabi, 2010).

Purpose of the study

The aim of this study was designed to investigate the effectiveness of advance organizer model on students' academic achievement in learning work and energy: the case of Adwa College of Teacher Education. The study was designed to achieve the following specific objectives:

1. To compare the effectiveness of advance organizer model (AOM) with the conventional teaching method (CTM) on students' academic achievement in learning work and energy.
2. To compare the effectiveness of advance organizer model (AOM) with the CTM under the category of objectives: knowledge, understanding and application.

3. To compare the effectiveness of advance organizer model in teaching male and female students.

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference between the means of the post-test of the experimental and control groups.
2. There is no significance difference between the means of the experimental and control groups under category of objectives: knowledge, understanding and application.
3. There is no significant effect of gender (male and female) on students' physics academic achievement after being taught work and energy with advance organizer model.

Conceptual Framework

Models of teaching

Models of teaching are like plans, patterns, or blueprints present the steps necessary to bring about a desired outcome (Joyce and Weil, 2004). Models create the necessary environment, which facilitates the teaching learning process. It consists of guidelines for designing educational activities and environments. It is designed to achieve a particular set of objectives. There are many powerful models of teaching designed to bring about particular kinds of learning and to help students to learn more effectively. According to Joyce and Weil (1986), teaching models are prescriptive teaching strategies designed to accomplish particular teaching goals. There are many models of teaching that are built around the mental process as ranging from systems for teaching general problem solving ability to procedure for teaching process.

According to Joyce and Weil (2004), the components of a teaching model are Syntax, Social system, Principles of reaction, Support system and Instructional and nurturing effects. Model of teaching has many purposes. Functions of models of teaching are designing curriculum or course of study, development and selection of instructional materials and guiding teacher's activities (Eggen and Kauchak, 2011). There are many models of teaching that are built around the mental process as ranging from systems for teaching general problem solving ability to procedures for teaching process. Joyce and Weil (2004) developed more than 20 models of teaching which are grouped on the basis of their chief emphasis. They organized these models into the following four basic families: 1. Information processing models, 2. Personal models, 3. Social interaction models, and 4. Behaviour modification models.

Advance Organizer Model

An advance organizer model is the member of information processing family. This model is a kind of cognitive bridge, which teachers use to help learners make a link between what they know and what are to be learnt (Novak and Gowin, 1984). Githua and Angela (2008) argued that advance organizers can refer to a relatively short arrangement of material introduced to the learner before the lesson. It is designed to cue the relevant prior knowledge of a learner and it is usually presented at a higher level of abstraction, generality and inclusiveness than that of the planned lesson (Curzon, 1990). Therefore, before beginning a lesson, teachers should ask questions, present a simple outline, or give students a few key words to help them focus on the major concepts (Willerman and Harg, 1991). Such strategies are called the advance organizers. Shihusa and Keraro (2005) argued that as long as advance organizers do their job of introducing new learning concepts and linking or developing new schema to relate the material, they can take many shapes including a simple oral introduction by the teacher, student discussion, outlines, advance organizers timelines, charts, diagrams, and concept maps.

According to Joyce and Weil (2004), there are two categories of advance organizers: expository and comparative. Expository organizers function to provide the learner a conceptual framework for unfamiliar material and comparative organizers are used when the knowledge to be acquired is relatively familiar to the learner. Willerman and Harg (1991) classified the components of advance organizer model in to five. These are: Syntax, Social system, Principles of reaction, Support system and Instructional and Nurtural effects. According to Joyce and Weil (1986), teachers offer a three phase of advance organizer model of teaching that includes "the presentation of the advance organizer, the presentation of the learning task or material, and the strengthening of cognitive organization" (p. 255).

Conventional teaching method

This approach is highly structured and teacher-directed approach. The major goal of direct instruction is maximization of students learning time. In conventional (traditional) teaching method, the teacher is the authority and the students are passive learners (Novak and Gowin, 1984). This type of structure has an elitist approach towards students. While some students are able to perform and solve complex problems in physics, they fail to apply basic knowledge in novel situations (Driver et al., 1994). Conventional teaching method is reminiscent of the popular perception of school. Students are instructed by the teacher to study the textbook. The teacher provides information to the students, including concepts, facts, terms, and diagrams (Aluko, 2008). Class periods are lecture based and involve note taking, usually through the use of a chalk board or white board. In this teaching style, it is expected that students will answer questions generated by their teachers. Carin and Arthur (1997) emphasized "no best method to guide learning in all situations." A method not only differs from the other by its elements and procedures but also in the ratio of teacher dominance to amount of student participation.

Concept of Work and Energy

Research concerning energy teaching focused mainly on the importance given to the conservation principle when compared with other aspects of the energy concept, in particular energy degradation (Driver, 1994). For physicists, conservation, which implies that energy is a quantifiable concept, is the basic characteristic of energy (Solomon, 1985). Researchers have presented ways of characterizing the different approaches to teaching about energy. Work and energy are already part of students' everyday language and experience (Lijnse, 2004), the development of energy understanding in the direction of energy conservation is challenging (Driver, 1985).

The development of energy understanding involves understanding many aspects of energy such as energy source, transfer, transformation, and conservation. To be scientifically complete and sophisticated, understanding should be based on energy as a conserved quantity. Students' overall understanding can progress toward energy conservation by identifying energy sources in a system and connecting various forms of energy and energy transfer processes to changes occurring in the system. In addition, students should be able to recognize and use energy concepts across mechanical, thermodynamic, biological, chemical, and technological applications (Lee and Liu, 2010). Findings indicated that when students asked to generate their own ideas, they often consider energy as human-related, depository, activity-related, or as an ingredient, product, function, or fluid-like substance (Reinertsen, 2013).

Methodology

Research Design

The design of the study was quasi-experimental: pretest post-test nonequivalent groups. Best and James (2003) suggested that quasi-experimental designs are used when randomization is impossible. In quasi-experimental designs the participants are not randomly assigned to groups and the experimental and control groups are not equivalent on variables that may affect the dependent variable (Best and James, 2003). According to Cohen et al. (2007), one of the most commonly used quasi experimental designs in educational research can be represented as:

Experimental O1 X O2

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Control O3 O4

The dashed line separating the parallel rows in the diagram of the nonequivalent control group indicates that the experimental and control groups have not been equated by randomization. The researcher used the quasi-experimental (pretest and post-test nonequivalent groups), since in educational research there were many factors that hindered to perform true experimental design.

This study was conducted on total population of 139 first year physics students in Adwa College of Teacher Education which is found in Central zone of Tigray, Ethiopia. Purposive and random sampling techniques were used to determine the sample size, that is, in Adwa CTE there were three first year Physics sections and all of them were taken pretest from work and energy and the two sections with equivalent means were selected to participate in the study purposely. The researcher used the purposeful sampling technique to control previous students' academic achievement that may affect the post-test result of students. From the two selected sections with equivalent means, one section was assigned as an experimental group and the other was assigned as control group randomly.

Instrumentation

Lesson plans

The lesson plan for the experimental group was prepared using the advance organizer model. In this model there are three phases of teaching: phase (1) the presentation of the advance organizer, phase (2) the presentation of the learning task or material, and phase (3) the strengthening of cognitive organization. Since the time for single period in Adwa CTE was 50 minutes, it was very difficult to apply all the phases of these models in single period. Thus, the different phases of this model were selected by the researcher according to the contents of the topic and the grade levels of the students to facilitate the teaching-learning process in class room instructions. This lesson was prepared in such a way those students actively participated with guidance of the teacher in the starter activity, main activity and concluding activity of the lesson. The lesson for the control group was prepared using conventional teaching method which was commonly practice in our College. This lesson has four phases of teaching: (1) Introduction, (2) presentation, (3) stabilization, and (4) evaluation. This type of lesson plan is practiced by the teachers in Adwa CTE in which the teacher is dominant whereas the learners are passive.

Achievement test (pretest and post-test) from work and energy

An achievement testing pretest was conducted to know the previous knowledge of students about work and energy and to take two sections with similar means to participate in the study and the post-test was also administered to investigate the effectiveness of advance organizer model on students' academic achievement in learning work energy. Each of the tests (pre and post) contained 20 multiple choice questions. One score was assigned for each correct answer. Items were prepared keeping in mind the objectives of learning and the content of the topics. Adequate directions were provided in the question paper and answer sheet was also provided at the last page of the questions. It should be noted that out of the 20 questions: five were knowledge level; seven were understanding level; and eight were an application level. The maximum marks for the test were 20, that is, one mark for one question. Table1 presents the load given and the item for each of the three objectives in constructing of the pre- and post- tests.

Table1. Load given to objectives of the pretest and post-test

Objectives	No of questions	Mark	Percentage (%)	Items	
				Pre-test	Post-test
Knowledge	5	5	25	1,6,7,13,17	1,6,8,13,17
Understanding	7	7	35	2,3,8,9,10,12,20	2,3,5,7,9,10,12
Application	8	8	40	4,5,11.14,15,16,18,19	4,11,14,15,16,18,19,20
Total	20	20	100	20	20

Table 2 below depicts the number of questions and periods for the contents of the lesson under study (i.e. work and energy) for each of the three objectives (knowledge, understanding and application) in both the pre- and post-tests.

Table 2. Blueprint (table of specifications)

Contents	No of periods	No questions for each objectives			
		Knowledge	Understanding	Application	Total
Work as a scalar product and work done by constant and variable forces	3	2	3	2	7
Kinetic energy, work energy theorem and Potential energy	5	2	1	3	6
Conservation of energy, conservative and dissipative forces	4	1	3	3	7
Total	12	5	7	8	20

Statistical techniques employed

Since the research was quantitative, it has its own appropriate statistical data analysis tools (Best and James, 2003). The pretest and the post-test score of the experimental and the control groups were analyzed using independent samples t-test and Levene's test using SPSS (v.20) Statistical Software and Excel. The hypotheses were analyzed at p=0.05 to see the statistical significance difference between the experimental and control groups.

To compute the item's difficulty (*P*-value) of the pre- and post-tests the following formula given by Abiy et al. (2009) was used:

$P = \left(\frac{A}{N}\right) 100\%$, where *A* and *N* are the number of students who answered the item correctly and the total number of students who attempted, respectively.

To determine the quality of the items of the pretest and post-test, discrimination index (D) of the items was calculated using the following formula given below by Ebel and Frisbie (1991).

$D = \frac{A-B}{N/2}$, where A, B, and N are the number of correct scores from the high scoring group, the number of correct scores from the low scoring group, and the total number of students in the two groups, respectively.

The reliability of the pretest and post-test were calculated using the Spearman-Brown formula: $\text{Reliability} = \frac{2r}{1+r}$, where ‘r’ is the actual correlation between the halves of the instrument. That means ‘r’ is either a Spearman rank order correlation or a Pearson product moment correlation.

In calculating the effect size (Eta squared) for independent samples in a t-test the following formula below was used.

$\text{Effect Sise(ES)} = \frac{t^2}{t^2+N_1+N_2-2}$, where t, N1, and N2 are the t-value calculated by SPSS, the number in the sample of group one, and the number in the sample of group two, respectively.

Validity and reliability of the instruments

The achievement tests for pretest and post-test were 20 multiple choice questions each from work and energy. These questions and the lesson plans were checked by two physics teachers from Addis Ababa University via e-mail and two physics teachers from Adwa College of teacher education using reviewing checklist to check the internal validity. In addition, the questions and the lesson plans were modified using the comments from the experts. Moreover, the questions were constructed with the help of Blueprint to check the content validity and also the researcher take care the difficulty level of the two tests, that is, the pretest and post-test questions had the same content and difficulty level but different forms in the construction of the test since the score of the students in the pre- and post-tests may vary due to difference in their difficulty than the difference in the treatment. In administering the tests, the teacher seriously controls the students in order not to cheat each other, as cheating decrease the validity of the tests. The researcher also returned the answer sheet to few students and the score were accepted by the students. Thus, the respondent validity was checked and also both type I and type II errors were minimized.

The internal consistency of the tests was checked by asking similar questions in different items of the tests and the reliability of the tests was checked by using split half method that is, 20 first year physics students were selected randomly from Abiyi Adi College of Teacher Education which was found on different area of the study as pilot test and the questions were administered to 20 students and the students' marks were split into two halves and the researcher took care to make the two halves had equivalent difficulty level.

First, the correlation of the two halves was calculated and it was found that the correlations of the pretest and post-test were 0.65 and 0.76, respectively. In addition, Cronbach-alpha reliabilities of the pretest and the post-test were 0.72 and 0.81, respectively, which were within the range of good reliability.

The item discrimination (D) of the 20 items of the pretest was between 0.37 and 0.71. This means that items 2,3,5,6,7,9,11,12,14,15,16,18 and 20 were good items, and items 1,4,8,10,13,17 and 19 were very good items. In addition, the item discrimination of the 20 items of the post-test was also between 0.39 and 0.69. This means that items 1,3,5,6,7,13,15,16,17,18,19 and 20 were good items and items 2,4,8,9,10,11,12 and 14 were very good items. Generally, all the items were good and accepted. This means that no item was rejected. The item difficulty (P) of the 20 items of pretest was between 0.35 and 0.64 and that of the post-test was between 0.3 and 0.6 which were accepted. This means that the questions were neither easy nor difficult.

Pretest

The aim of the pretest was to know the previous students' academic achievement about work and energy and to select two sections with equivalent means to be assigned as experimental and control groups. The Achievement test (pretest) was administered at the same time to the three sections of first year physics students before they learnt work and energy and the test was administered and collected with the help of physics teachers in Adwa CTE and also the researcher controlled any form of cheating among the students. The pretest results of the three sections are given in table 3. Thereby, table 3 summarizes the means of the pretest result of the three sections of first year physics students which enabled the researchers to take two sections with equivalent means.

Table 3. Means of the pretest of the three sections

Sections	No of students	Mean
A	53	6.58
B	44	7.9
C	42	8.4

As it can be seen from table 3, section B and C have equivalent means whereas section A has mean far from the means of the rest of two sections. Hence, the two sections with equivalent means were selected purposely. Then the significant difference of the two sections B and C were tested by using t-test for independent samples. Hence, table 4 summarizes the mean and the statistical significant difference using independent sample t-tests for the two sections with equivalent means.

Table 4. Test for significant difference of the two sections using independent samples t-test

Type of test	Section	N	Mean	Std. Dev	Std. error	df	t	Sig. (2-tailed)
Pre-test	B	44	7.9	1.851	.231	84	.771	.251
	C	42	8.4	1.521	247			

As it can be seen from Table 4 at the column 'Sig. (2-tailed)' the significance level is 0.251 (i.e. ρ >0.05).This tells that there is no a statistically significant difference between the pretest mean of the two sections. Thus, the two sections B and C in the study were assigned randomly as control group and experimental group, respectively.

The experimental and control groups

Primarily, one teacher who gave the course to first year physics students was trained by the researcher for five days about advance organizer model and how this model is applied in teaching physics. This teacher taught the experimental group with the help of lesson plans based on advance organizer model and 12 lesson plans were prepared for four weeks to teach the topics from work and energy. In the experimental class room, the teacher presented different types of advance organizers in front of the students and asked students to observe them and to reflect what they understood from the organizers either at the starter activity, main activity or concluding activity of each of the 12 lessons. The advance organizers which were used in this study were: 1. Expository - simply describes the new content, 2. Narrative - presents new information in a story format, 3. Skimming - skimming material before reading, and 4. Graphical organizers - effective with all types of organizers: pictographs, descriptive patterns, concept patterns. The control group was also learning the same topic with equal duration of time by the same teacher as that of the experimental group using the 12 lesson plans based on conventional teaching methods. This means that the teacher used the actual lesson plans commonly practiced in the college class room instruction without advance organizers.

Post-test

After the two groups were thought by the same teacher for four weeks with their own lesson plans about work and energy, the post-test was administered to the two groups simultaneously to investigate the effectiveness of advance organizer model in teaching work and energy. Thereby, the test was administered and collected with the help of physics teachers in that college and the researcher controlled the class seriously for any form of cheating among the students.

Data Analysis and Interpretation

Pretest and post-test results of the experimental and control groups

The result of the pretest and post-test of both the experimental and control group students were analyzed using independent sample-t-test since the data in this study were parametric and ratio scales. Obviously, in order to use this t-test, the data distribution needs to satisfy the assumption of normality (Schucany and Tony Ng, 2006). Thereby, the scores of the pretest and post-test of both the experimental and control groups in the population were satisfied the normal curve distribution or the bell-shaped symmetry of the Gaussian curve of distribution. Table 5 summarizes the mean difference and statistical significance difference by analyzing the pretest and post-test result of both the experimental and control group students using independent samples t-test.

Table 5. Independent samples t-test for pretest and post-test result of experimental and control groups

Type of test	Group	N	Mean	Std. Deviation	Std. Error Mean	Df	T	Sig.(2-tailed)
Pretest	Experimental	42	8.4	1.521	.247	84	.771	0.251
	Control	44	7.9	1.757	.231			
Post-test	Experimental	42	15.2	1.882	.268	84	8.615	0.000
	Control	44	12.1	2.113	.249			

Table 6 describes the mean and statistical significant difference of the post-test result of the experimental and control group students under category of knowledge, understanding and application by using the independent sample t-test.

Table 6 Independent samples t-test for post-test result under category of objectives: knowledge, understanding and application

Type of Objectives	Group	N	Mean	Std. Deviation	Std. Error Mean	Df	T	Sig. (2-tailed)
Knowledge	Experimental	42	3.66	.831	.126	84	.712	0.341
	Control	44	3.43	1.21	.155			
Understanding	Experimental	42	5.19	.817	.122	84	8.256	0.000
	Control	44	3.65	.923	.145			
Application	Experimental	42	6.26	1.221	.181	84	8.451	0.000
	Control	44	3.89	1.733	.177			

Table 7 shows the independent samples t-test for post-test result of male and female students in the experimental group.

Table 7. Independent samples t-test for post-test result of male and female students in the experimental group

Type of test	Gender	N	Mean	Std. Deviation	Std. Error Mean	Df	T	Sig.(2-tailed)
Post-test	male	24	14.98	1.641	.352	40	-0.561	0.404
	Female	18	15.42	1.783	.349			

Discussion

As it can be seen from the table 5 above, the probability value (ρ) of the pretest in the column 'Sig. (2-tailed)' is 0.251 which is greater than the significant level. This tells that there is no a statistically significant difference between the means of the pretest of the experimental and the control groups. Hence it is possible to say that the null hypothesis is supported. This means that there is no a statistically significant difference between the mean of pretest of the experimental group (8.4) and the mean of pretest of the control group (7.9). This shows that the two groups do not differ significantly in the initial academic ability of students. So it can be concluded that the two groups more or less have the same ability before the treatment because the two groups taught using the conventional teaching method before the treatment.

In the table 5 above, the probability value (ρ) of the post-test in the column 'Sig. (2-tailed)' is 0.000 which is less than the significant level. This tells that there is a statistically significant difference between the two means of the post-test result of the experimental and the control groups, because the significance level is 0.000 (i.e. ρ <0.05). Hence, it is possible to say that the null hypothesis is not supported, that is, there is a statistically significant difference between the means of post-test result of the experimental and control groups. So it can be concluded that advance organizer model is more effective than the conventional teaching method in teaching work and energy. This result agrees with Githua and Angela (2008) finding. Githua and Angela (2008) performed their investigation on secondary school students' mathematics achievement. It is obvious that the effect size is just the standardized mean difference between two groups. Thereby, to see how the effect size (ES) was big between the two groups of experimental and control, a modest ES of 0.49 was calculated according to Cohen et al. (2007). This effect size was almost similar to that of ES of 0.54 which was obtained by Shihusa and Keraro (2009).

As it can be seen from Table 6, there is no a statistically significant difference between the two means (ρ = 0.341, i.e. ρ >0.05) of the post-test result of the experimental and the control groups respect to the category of knowledge. Hence, it is possible to say that the null hypothesis is supported and there is no a statistically significant difference between the means of the two groups, i.e. both advance organizer model and the convectional teaching method are equally applicable to teach facts, terminologies and principles of work and energy on the category of the objectives of knowledge. This result coincides with the finding of Bajpai (1986) even though his study was focused on the attainment of concepts. On the other hand, the mean score of the post-test result of the experimental group under category of understanding on the variable 'the effectiveness of advance organizer model' (M=5.19, SD=.817) is statistically significantly higher {*t* = 8.256, *df*= 84), two tailed (ρ = 0.000)} than the mean of the control group under the category of understanding (M = 3.*65*, SD = .923). This result agrees with the findings of Chung (1996). Finally, this finding concluded that AOM is more effective than CTM under the category of understanding. Since effect size is an important tool in reporting and interpreting effectiveness of a particular intervention, relative to some comparison, a moderate effect size (ES) of 0.41 was calculated according to Cohen et al. (2007).

Moreover, from Table 6, it has been shown that the mean score of the post-test result of the experimental group under category of application on the variable 'the effectiveness of advance organizer model' (M =6.26, SD = 1.221*)* is statistically significantly higher {*t* = 8.451, *df*= 84, two tailed (ρ = 0.000)} than the mean of the control group under the category of application (M = 3.89, SD = 1.733). So, it can be concluded that the students taught by advance organizer model performed better than those taught by using the conventional method of teaching under the category of application. This result confirms the finding of Shamnad (2005) under category of application, even though his treatment was focused on concept attainment model. In addition, a modest effect size of 0.47 (Cohen et al, 2007) was calculated between experimental and control groups under the category of application.

Finally, as it can be seen from table 7, there was no statistically significant difference between the two means of male and female students (ρ = 0.404, i.e. ρ >0.05). Hence, it is possible to say that the null hypothesis is supported and there is no statistically significant difference found between the means of males and females i.e. advance organizer model is equally effective to teach work and energy to male and female students. This result agrees with the finding of DaRos and Onwuegbuzie (1999), even though their study was focused on research methodology course.

Conclusion

In conclusion, the advance organizer model is more effective than conventional teaching method in teaching work and energy for first year physics students in Adwa College of teacher education to develop their academic achievement**.** The findings of the study show that the advance organizer model was more effective than conventional teaching method with effect size of 0.49. Both the advance organizer model and conventional teaching method were effective in teaching work and energy under the category of knowledge. The advance organizer model was more effective than the conventional teaching method in teaching work and energy under the category of understanding and application to enhance students' academic achievement. This model was also equally effective to improve the academic achievement of male and female students in teaching work and energy.

Recommendation

Based on the findings, the advance organizer model is definitely better than the conventional teaching method to enhance students' academic achievement in teaching work and energy under the category of understanding and application. Since the application of models of teaching in the classroom facilitated better learning activities, the advance organizer model shall be introduced in Adwa College of teacher education.

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