EFFECT OF ADVANCE ORGANIZER TEACHING STRATEGY ON SECONDARY SCHOOL STUDENTS' CONCEPTUAL UNDERSTANDING OF STATISTICS TOPICS IN MATHEMATICS IN MERU SOUTH, KENYA

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ABSTRACT

This study investigated the effect of advance organizers teaching strategy on the secondary students' conceptual understanding of topic statistics in mathematics, in Meru South, Kenya. The learning requirement in the 21st centuary is to develop life long learners who are able to cope with emerging issues in life. Mathematical knowledge and skills are required especially in high technological advancements in society. They are made of of principles, theories, constructs and concepts that need to be developed to meet emerging challenges. Topics in mathematics have unique level of learning challenges. This has made many students to perceive the subject as difficult leading to poor performance as compared to sciences such as biology, physics and chemistry. Mathematics instructional methods have been identified among the factors contributing to the problem of poor performance in secondary schools mathematics in Kenya. This study, therefore, sought to reverse this trend in performance. The research was based on constructivists' theory pioneered by Ausubel. Solomon four quasi- experimental research design was used. Students in the experimental groups (E1 and E2) were taught using advance organizer teaching strategy and students in the control groups (C1 and C2) were taught using convectional teaching methods. The target population was all Form two students in 56 public secondary school of Meru. Purposive sampling was used to draw four Co-educational schools in Meru South. Assignment of the schools to either experimental or control group was done through simple random sampling. The sample size of the study was 168 students.' The instrument was Mathematics Conceptual Understanding Achievement Test (MCUAT). The research instrument was pilot-tested in a school in a secondary school with similar characteristics as the study sample in Maara Sub - County. Reliability was estimated using cronbach coefficient alpha method. The instrument yielded a reliability coefficient of 0.75. Data was analyzed using descriptive statistics (mean and standard deviation) and inferential statistics (t-test, One-way ANOVA and Post-Hoc) analysis which was undertaken using Statistical Package for Social Sciences version 25.0 at 0.05. The findings established that students taught using advance organizers had a higher level of conceptual understanding of statistics topic than those taught using conventional teaching methods. Thus mathematics teachers should ensure there is proper planning and preparation of learning materials to be presented prior to lesson presentation.

Keywords: Teaching strategy, Conceptual understanding, Teaching statistics

INTRODUCTION

Mathematics education is the practice of teaching and learning mathematics. It is concerned with tools, methods and approaches that facilitate practice of the study of practice. Mathematics become a central part of the curriculum from an early age. Basic numeracy skills such as the ability to count money and carry out simple arithmetic became essential as early as the 18th and 19th century. In modern society, rapid change in technology affects mathematics instruction in primary, secondary and higher education (Alacaci, 2014). Alternatives teaching and learning practices are needed for meeting these challenges especially in secondary schools. Secondary mathematics aims at producing a person who is numerate, orderly, logical, accurate and precise in thought (KIE, 2002). The person should be competent in appraising and utilizing mathematical skills in playing a positive role in the development of modern society. This requires emphasis in application of mathematics to real life experiences and practical approaches to teaching and learning in an effort to address such contemporary issues such as information technology, covid 19 pendemic in health, gender and integrity.

Research in teaching methods has proved that these challenges can be addressed by applying the relevant teaching methodologies (Makewa, 2014). Effective teaching strategies should be able to change students ways of thinking about mathematics. Teaching mathematics appropriately is both needed in the modern day world. Mathematical understanding builds not foundation from mathematical meaning. According to Jones (2012), keying numbers in calculators or computer do not imply mathematical understanding. The learner needs to develop appropriate strategy

for approaching real life problems. Learning develops when learners construct their own knowledge. Constructivism theory of learning emphasis human being construct their own knowledge. Teachers do not transmit knowledge but rather facilitates knowledge transfer (Jones, 2012). The ability to transfer new knowledge into new situations and apply it in new contexts is what is conceptual understanding. Learners require to know more than isolated facts and methods to relate math ideas in an interconnected and organized way and the kind of contexts it is useful.

Many teachers in Kenya use expository learning strategies which do not enable students develop conceptual understanding There are no relating of new content to the learners environment so to create meaning to the learner (Alvarez & Risco, 2007). Failure to relate content to the learners environment may result to students perceiving subject as difficult (Musaisa et al., (2012). Students should be made to understand the mathematics knowledge as made up of coherent structure of concepts which are inter connected together. Meaningful learning tools such as concept maps and advance organizers are developed on conceptual and theoretical framework of the new knowledge the students must learn. Deep conceptual understanding requires mathematical reasoning. The students need to know the process and reason behind every step in problem solving. This is termed as relational knowledge.

Another type of knowledge is conceptual procedural knowledge which focus on how to do arithmetic. This is when a learner is able to understand the meanings and underlying principles of mathematical concepts (Fredrick & Kirsch, 2011). According to Reys & Suydam; Lindquist, 1995 as cited in Jones (2012), knowledge that is conceptual interconnects thus makes the learner to be active in thinking about relationship and making connections, and adjustments to accommodate new learning. Students demonstrates conceptual understanding when they recorgnize, label and generate examples of mathematical concepts, identify and apply principles, signs, symbols and terms that represent various concepts in mathematics.

The ministry of education introduced in-service for teachers training called Strengthening of mathematics and sciences in secondary school education (SMASSE) in 1998 in collaboration with Japan Government. The SMASSE project emphasized experimental methods and improvisation leaving out other strategies dealing with interconnecting previous knowledge to new knowledge. The topic of statistics is applicable to the learners day to day lives. In business activity, industry, in research study which make it relevant for this study. However, when students are examined in the National examination in the topic statistics, performance in the questions is poor (2015-2019). Conventional learning strategies are unable to improve conceptual understanding and problem solving in mathematics (Jazuli et al., 2012). Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge (Cumming, 2015). Conceptual knowledge enables learners to avoid errors while solving problems since they are able to connect algorithm correctly and communicate results.

Methods which is teacher dominated Mathematics is more than just a science of numbers taught by teachers in schools and enjoyed or feared by many students (Mulheim, 2013). The use of mathematical knowledge in every field of study and industry produces new discoveries and emergence of new discipline. This adds to new knowledge. Therefore, a mathematics teacher should develop a positive attitude and good relationship with learners during instruction. The teacher should stress the classroom activities that involve teaching learning process and students' participation in the class. Different strategies of teaching mathematics have been proposed by educators and the knowledge of these strategies help in working out better teaching strategy that improve students' mathematics achievement Muthomi, (2013). The approach adopted must ensure maximum participation of the students, proceed from the concrete to abstraction and provide knowledge at the understanding level (Merchant, 2010).

According to Barchok (2011), better results in learning are achieved when the most suitable methods are fed into the teaching system in the best way possible. Effective teaching and learning mathematics depends largely on approaches that take into consideration spiral nature that exposes the student to a basic concept in a given topic and prepares him psychologically for a more complex topic ahead. The teaching strategies employed currently do not help the learners to answer questions which approach the curriculum topics from various angles and perspectives (KNEC, 2018). Despite the use of various teaching strategies in teaching of mathematics, the conceptual understanding as reflected in KCSE National performance in mathematics has always been low compared to other subjects. The National performance in mathematics is presented in Table 1. The highest recorded mean score was 31% in paper one and the lowest 17.84% in paper two for a period of five years (2015- 2019). The low performance can be attributed to low conceptual understanding in mathematics. This situation is not different in Tharaka Nithi County especially Meru South Sub- county.

Manoah et al., (2011) points out that poor performance in mathematics is due to factors such as teachers not using students centered approaches, lack of experiments and practical modeling activities and lack of professional

exposure that could have articulated issues related to teaching of mathematics in secondary schools. According to Barton (2000), attitude towards mathematics learning plays a crucial role in the teaching and learning processes. The teachers' strategies of teaching and personality greatly account for the development in mathematics.

Table 75. Candidates Performance in Mathematics for the Period (2015 to 2019)

Year	Candidature	Paper 1 Mean score	Paper 2 Mean score	Average Mean score	Standard Deviation
2015	520274	25.53 %	28.73%	27.13%	40.87
2016	570398	23.74%	17.84%	20.79%	41.87
2017	609525	24.49%	26.47%	25.48%	43.46
2018	658904	24.07%	28.82%	26.45%	41.10
2019	694445	31.00%	23.00%	27.00%	43.91

Source: KNEC Report, (2019)

In addition to previous studies, the 2009 situational analysis conducted by Center for Mathematics, Sciences and Technology Education in Africa (CEMASTEA) revealed that learners enjoyed learning mathematics and sciences when there was a deliberate effort to make them understand the applicability of the content in real life situation and future careers. The study found minimal collaboration among teachers and inadequate opportunities for learners to interact in groups. On nature of investigative skills, only less than 10 % of the observed lesson promoted the investigative skills. The strategy adopted by the teacher must ensure that student participate maximumly proceeding from the concrete to abstraction and provide knowledge at the understanding levels. After the teacher has known all the teaching methods their merits and demerits, they should use the strategy that has good qualities of all the approaches (Merchant, 2010).

Incorporation of effective teaching strategies like the use of advance organizer in mathematics instruction enhance students' conceptualization of mathematical concepts and motivate them to improve their academic achievements. Changeiywo (2000) and Kiboss (1997) notes that most of the approaches used in Kenyan schools are mainly expository and fact oriented making students passive. These approaches are partly to blame for poor achievement in the subject (Oyaya & Njuguna, 1999). Some teachers use book as the only teaching resource and hardly address the requirement specific in the Kenya syllabus (Akala, 2002). This often leads to coverage of irrelevant materials and exclusion of crucial parts of the syllabus. According to Githua (2002) and Scott (1997), some teachers use revision of question from tests and past papers examinations which results to rote learning. In this approach, students are asked to answer question from past papers after which teacher mark and give them feedback. However, this approach is limited to preparing students for examination. Other approaches that promote deeper understanding of the concepts are necessary before this approach can be used.

An advance organizer is an organizational frame work that teachers present to students prior to teaching new content to prepare them for what they are about to learn (Githua & Nyabwa, 2008). This was enhanced by advance organizer teaching strategy. Advance organizer is a kind of cognitive bridge which the teachers use to help learners make a link between what they know and what is to be learnt (Novak, 1980). Advance organizer refer to materials introduced to learners before the lesson designed to cue his or her relevant prior knowledge presented at higher level of abstraction, generality and inclusiveness than that of the planned lesson(Curson,1990). Ausubel (1963) asserts that cognitive restructuring process leads to positive learning outcomeThe advance organizer strategy may reverse rote learning trend. Advance organizer make concepts and facts more clear to the learner so that they can find out relationship between the concept they acquire from the books and the facts that happen in real life situation

Learners are seen not just as accessing association but also restructuring meaning. This is by processing new input through existing cognitive structures and then transferring it to long term memory where it may undergo further processing and possible reconstruction (Good & Brophy, 1995; Okere, 1996). Good and Brophy further points out that constructivists assume the retention of new learning depends on the degree to which learners can activate existing cognitive structures or construct new ones to subsume the new learning and provide access to it later. They also assume that the material stored in memory can be elaborated or distorted not just retained as if else forgotten.

Keraro (1902) argues from birth individuals construct and restrict meanings of events and objects they observe. Ausubel (1968) notes that the most important factors influencing learning is what the learners already know.

Therefore, understanding what the learner know and guiding the student to build upon them is the essence of teaching. According to Driver and Dult (1971), meaningful learning is active creation of knowledge structures that are based on individual's experience. They further view learning as a social activity where learners interact with each other as well as their teachers. This links very well with this study since the teacher need to understand what the learner know and then guide them. This study is based on the Ausubellian theory of advanced-organizers propounded by David Ausubel. The theory of advance organizer focuses on meaningful verbal learning. This theory emphasizes and contributes to the aspects of cognitive learning that encourages rapid learning and retention abilities. When new concepts are related to any of the information already existing in the learners cognitive structure then appropriate learning can take place. Meaningful learning and retention occurs when there is an interaction between previously obtained knowledge and new knowledge. Therefore, where no previous knowledge exists what occurs is referred to as rote learning. Another thing that occurs in the absence of relevant anchorage for new learning to take place in students is forgetting. Forgetting occurs because certain details gets integrated but then lose their individual identity. In the absence of previous knowledge Ausubel advocated for advance organizers to bridge the gap between new material and existing related ideas. In preparing for advanced organizers and to ensure effectiveness of the teaching, Ausubel states two conditions; The students must process and understand the information presented in the organizer, the organizer must indicate the relationship among the basic concepts and terms that was used in the topic to be learned. (Woolfolk, Winne, Perry, & Shapka, 2010).

Students are able to build more complex cognitive structures and deepen their understanding and retention of scientific concepts when teachers help them link old knowledge with new ones by giving students Advance Organizers (A.O) in addition to text materials and the lesson itself. The existence of relevant anchoring ideas in the cognitive structures is the primary pre-requisite for subsequent meaningful learning. Ausubel (1978), emphasized that in order to ensure relevant anchoring of learners' ideas, advanced organizers should be given to students. Ausubel (1968) and Allen (1970) earlier supported the use of Advanced Organizers; the advantages among others include providing anchorage or links and avoidance of rote memorization by students.

Mayer (1979) further explains Ausubel's theory in terms of his assimilation encoding theory. He emphasized that if the learner already has previous knowledge of the content to be learnt, the A.O would not be as effective as when the student is new to the content material. Hence A.O is effective for new learning. Results of several studies have revealed the efficacy of using advance organizers in teaching students. It is very easy for teachers to learn how to use advance organizers in their classrooms with minimal training, and is easy for students to show interest in using advance organizers.

According to Ausubel (1968) meaningful learning occurs when known knowledge is consciously linked by the learner to the existing specifically relevant concepts and prepositions in the cognitive structures and is incorporated within the structure. He further argues to achieve learning three conditions must be present. The new material must be inherently meaningful; learners cannot meaningfully learn nonsense syllabi or randomly scrambled textual material. The learner must have a meaningful learning set. This is by actively trying to link new knowledge with existing relevant knowledge. The learner must possess 'relevant concepts'. According to Charlesworth, (2012), concepts are building blocks of knowledge. Therefore, its necessary for teacher to incooporate effective teaching strategies in their methods or approaches in teaching of mathematics. Promoting hands on activities by teacheers enables learners manipulate onbjects, they think about the objects properties and relationship. After several trials, manipulation of the objects may lead to conceptual understanding (Bhangwanji, (2011). Conceptual understanding of mathematics on hands on provides an opportunity for appropriate teaching strategies.

Barchok (2011) argues that effective teaching strategies are designed to promote efficient and meaningful learning and rely upon connecting prior knowledge to new concepts. Students should be guided to make conclusions and generate hypotheses in order for them to understand how general mathematics principles and laws come about. These conclusions and hypotheses are based on unempirical data obtained by students themselves during classroom experiments or with the assistance of their teacher during classroom demonstration (Okere, 1960).

The Government of Kenya has put a lot of emphasis on provision of quality education and training programs to its entire citizen not only to meet the demands for the 21st century but also so as to compete favorably with the international standards. However, despite the substantial allocation of resources to education, the sector is still faced with challenges which are likely to undermine attainment of the projected goals and envisaged under vision 2030 development strategic plan. One of the notable challenges facing secondary education islow conceptual

understanding in mathematics as reflected by poor performance in Mathematics among students'. The problem of poor conceptual understanding has been addressed by many innovates yet the performance is still poor. There has been limited research on advance organizer that provides empirical data on effects of advance organizer on student conceptual understanding in mathematics in secondary schools of Meru South Sub - county. It is on the basis of these reasons that the present study was designed.

The purpose of this study was to determine effect of advance organizers teaching strategy on secondary school student's conceptual understanding in the topic Statistic in mathematics, in Meru South. The objective was to determine effects of Advance organizer teaching strategy on secondary school students' conceptual understanding in the topic statistics in mathematics. in achievement. The hypothesis was that there is no statistically significant difference in conceptual understanding between Students exposed to Advance Organizer and those not exposed to it in the topic Statistics in mathematics.

Research Design

The study involved quasi- experimental research design and in particular Solomon four non – equivalent groups. The Quasi-experimental chosen allows for assessment of causal effects of A.O teaching strategy on students post instructional achievement, as well on their motivation towards mathematics learning. The design is appropriate because once secondary school classes are constituted, they exist as intact groups and school authorities do not normally allow such classes to be broken up and reconstituted for research purpose (Nachmias & Wachmias, 2004). The design is rigorous thus was used in quantitative studies for it involves two control groups as compared to other experimental designs (Ogunniyi, 1992).

The design makes it possible to evaluate the main effects of testing history and maturation (Fraenkel & Wallen, 2000). The Solomon –Four group designs enables the researcher to control and measure the main effects of testing. The effects of regression were taken care of by two groups not taking the pre-test. This provides a check on the equality of the two groups on the dependent variable. A pre-test was administered to the experimental group (e1) and control group (C2) groups so and assesses the homogeneity of the groups before administration of treatment. The design helps in achieving the effects of treatment relative to the control condition, interaction between pre-test and treatment condition, between treatments

Solomon Four non -equivalent Group Design

Group 1 (E1)	0 1	X	02
Group II (C1)	03	_	04
Group III (E2)	_	X.....	05
Group IV (C 2	_	_	. 06

Figure 2: The Solomon Four- Group Design
Source: Adopted from Shuttleworth, (2009)

Key: EI and E2 are experimental groups
C1 and C2 are control groups
O is the observation
X is the treatment
is non -equivalents group

Figure 2 shows Solomon Four non-equivalent group design where(X) is treatment where students are taught using Advance organizers. O is observations. Group 1 is experimental group to receive the pre-test (O1), the treatment(X) and post-test (O2). Group II is the control group which is to receive a pre-test (O 3) followed by the control condition and finally a post-test (O4). Group III receive treatment (X) and post-test(O 5) only, but not receive pre-test while Group IV receive post-test (O 6) only. Group II and IV were taught through conventional teaching methods. To control interaction between selection and maturation the schools were selected randomly and assigned to control and treatment groups. The condition under which the instruments were administered were kept similar as much as possible across the schools to control for interaction between selection and instrumentation (Zechmeish & Shaughnessy, 1994). A teacher training manual was used to ensure that there was uniformity in teaching.

Sample Size and Sampling Procedure

The study sample was drawn from a population fifty six secondary schools. All the secondary schools were listed. Simple random sampling was used to obtain the study sample of four SubCounty schools. The schools were far apart

to ensure homogeneity in characteristic of the selected school. It was also done to minimize accessibility of the schools by the researcher. For those schools with more than one stream all participated in the study but through simple random sampling one stream was selected to take part in the study. Therefore, students from Sub county secondary schools took part in the study. Thus, the sample for the study was about 168 students'. For experimental studies at least 30 cases are required per group (Mugenda & Mugenda, 1999; Gall & Borg, 1996). The assignment of the four groups to either experimental or control group was done through simple random sampling (Table 3).

Table 3. Sample size

Group	Experimental/ Control	Sample
I	Experimental	44
II	Control	45
III	Experimental	43
IV	Control	36
Total		168

Adopted from: (Mugenda & Mugenda, 1999; Gall & Borg, 1996).

Instrumentation

A mathematics pre-test conceptual understanding achievement test (MCUAT) on mathematical concepts previously learned was developed. This helped to measure the entry level of the learners. The questions were reshuffled and administered as Post-test (MCUAT). The test comprised of about ten test items on conceptual development. Ideas are related to construction of frequency distribution, mean, median, histogram and frequency polygon preparations. The total marksf or the test was 40 marks. Each of the question was graded on four point likert scale. 0 represents students who never attempted the problem, 1 represented those, who attempted but got wrong answers, 3 represented those who got the question partially while 4 represented those who scored all marks of the question.

RESULTS AND DISCUSSION

The data generated was analyzed by both descriptive (mean, variance and standard deviation) and inferential (t-test, one way ANOVA, and Turkey post hoc) statistics. T-test was used to test whether there is any statistical significant difference between experimental and control groups on the conceptualization of the concepts in statistics. One-way ANOVA was used to show differences of more than two groups within the design. Scheffe's post hoc test of multiple comparisons was used to determine which group means disply significant difference at 0.05 level of significance. SPSS version 26.0 was used to compute data collected.

Effects of Advance Organizer on Secondary School Students' Conceptual Understanding of the Stastitics Topic in Mathematics

Achievement is a measure of quality and quantity of success in masterly of knowledge skills and understandings. Students achievement and understanding are significantly improved when teachers are aware of how students construct knowledge, use knowledge to solve problems, and utilize knowledge toplann and conduct instruction in mathematics. Conceptual understanding was perceived in assessment for understanding. This was done by assessing the ability of the student in demonstrating understanding of concepts and principles tested. This conceptual understanding was achieved through analyzing students' collect procedures in arriving to the final answer.

A pre – test was administered on two groups. The groups that were pre – tested were experimental group (E1) and the control group (C1). This was done before the commencement of advance organizer teaching strategy. This pre-test was useful in establishing the initial equivalence groups. Table 5 shows the results of pre-test scores on MAT. The results in Table 5 indicates that experimental group had a higher mean score (13.29) than control group C1. However, there was no significant difference in the two means ($t_{(87)=} 1.984$, $p>0.05$) which implied that the level of achievement prior to administration of the intervention for the two groups were similar; that is the groups E1 and C1 were treated as equivalent groups before administration of treatment. This made them suitable for the study. The absence of pre-test in group (E2) and group (C2) in this design constitute a distinct advantage in that it enabled the researcher to generalize to groups that did not receive pre- test as pre- test had no adverse effect on the experimental treatment. In order to determine the effect of A.O teaching strategy on conceptual understanding in mathematics the post test mean scores analysis was carried out and the results presented in Table 6.

Table 6 indicates that the highest mean scores was obtained by experimental group 1 followed by experimental group 3, then control group 2 and finally by control group 4. The standard deviation for both experimental and

control groups on post test are slightly different in favor of the experimental group. Comparing the conceptual understanding between the experimental and control groups, A.O has proved to have a positive effect on student conceptual understanding and so it is an effective teaching strategy. However, this observation is not sufficient to show whether the differences in mean scores are statistically significance at critical alpha 0.05 level. To test whether there was any ignificant difference on these means, One-way ANOVA was carried out (Table 7).

Table 5. Independent Sample t- test and Pre-test Mean scores

Variable	Group	N	Mean	S.d	df	t-value	p-value
	E_1	44	13.29	14.62	87	1.984	0.4
MAT	C_1	45	12.19	8			

Table 6. Post test Mean Scores Obtained by Students of the Four Groups

Group	N	Mean Score	Std. Deviation
1 Experimental ($E_{1)}$	44	14.95	2.29
2 Control ($C_{1)}$	45	12.29	2.31
3 Experimental ($E_{2)}$	43	13.25	2.46
4 Control ($C_{2)}$	36	12.20	2.04

Table 7. Analysis of Variance (ANOVA) Results of the Post –Test Scores

	Sum of Squares	Df	Mean Square	F	Sig.	P-value
Between Groups	211.3893	3	70.624	2.68	38.69	0.04
Within Groups	500.81	165	3.092			
Total	712.199	168				

Table 7 depicts the post-test means of the Four groups confirmed that the means of the Four groups were actually significantly different from each other (F (3, 165), $p< 0.05$) This indicates that advance organizer teaching strategy is effective in increasing students learning. The study is in consistent with another study by Cumming (2015) who found out that students who possess conceptual knowledge tend to avoid errors in solving problems and this enables perform well. Gurbuz, et al (2018) findings shown students in the experimental group constructed their knowledge more meaningfully and potayed better cognitive development. A study by Githua and Nyabwa (2008) on effects of Advance Organizers strategy during instruction on secondary school students' mathematics achievement established that use of Advance Organizers improved male and female students equally.

Studies have shown that advance organizers have led to improved students' achievement (Omotade, 2016; Nazimuddin, 2015; Mshenga, 2013; Montanero & Lucero, 2012; Agnihotri & Sharma, 2013; Babu & Reddy, 2013). A study by Atomatofa (2013) revealed that Advance lead to improved students' achievement and retention than those taught using conventional teaching methods. Studies have also demonstrated that advance organizers are associated with improved learning (Tamir, 1992; Dexter & Hughes, 2011; Dexter, Park, & Hughes, 2011). Maryam, Moenikia and Zahed-Babelan (2010) argue that advance organizers are effective ways to facilitate the task because they can provide an overview of a new topic and visually represent links between the concepts to be learned. A study by Korur, Toker and Eryilmaz (2016) revealed that the use of online advance organizers increases students' achievement scores. The findings are also in agreement with those of Kapri (2017) and Muiruri, Wambugu and Wamukuru (2016) who established that Advance Organizers improved students' achievement. After establishing that there was a significant different it was necessary to compare the results with pretest.

Table 8. A Comparison of the Mean Score Mean-gain Obtained by Students in MAT

Group	N	Pre-test Mean	S.d	Post-test Mean	S.d
E_1	44	13.29	14.62	14.95	2.29
C_1	45	12.19	8	12.29	2.31

The results in Table 8 indicates that there was a much higher improvement in mean score after the introduction of A.O teaching strategy as compared to group (C1) which was taught using conventional teaching methods. It is evidenced from the table that a higher mean score (14.95) was observed in favor of the experimental group. There is a mean gain (1.66) obtained in the post-test by the experimental which is slightly higher than (0.1) of the control

group. This emphasizes the position of advance organizer teaching strategy on in mathematical conceptual understanding. After treatment the level achievement was slightly higher than those in control groups. It was necessary to carry out further analysis to show where the difference exists. This is depicted in Table 9

Table 9. Scheffe's post hoc Comparisons of the MCUAT Post-test Scores for the Four Groups

Group	Goup	Mean Difference	p-Value
E1	E2	2.14	0.874
	C1	14.57	0.0001*
	C2	13.04	0.0001*
E2	E1	-2.14	O.874
	C1	11.65	0.0001*
	C2	10.78	0.0001*
C1	E1	-14.87	0.0001*
	E2	-11.34	0.0001*
	C2	-1.34	0.643
C2	E1	- 13.14	0.0001*
	E2	-10.91	0.0001*
	C1	0.0001*	0.74

Mean statistically significant at Alpha 0.05 level. $P < 0.05$

Results in Table 9 represents a no statistical significant mean score difference between (E1 and E2) and control (C1 and C2) groups since the P- value is less than 0.05. The results show that there was significance difference in mean score between E1 and C1, E1 and C2, E2 and C1, E2 and C2. There was no statistically significant difference between the mean scores of two experimental groups and control groups. However, there is statistically significant difference between posttest scores E1 and E2 compared to the control groups posttest scores C1 and C2. E1 –C1 = 14.57*, E1 – C2 = 13.04*, E2- C1= 11.65* and E2 – C2= 10.78*. This shows that the advance organizers teaching strategy was effective and students attained better results after using it. Thus, the null hypothesis was rejected and confirm that there is statistically significant difference in conceptual understanding between students taught statistics using Advance organizers and those taught using conventional methods.

SUMMARY

This study on effects of A.O teaching strategy on students' conceptual understanding in mathematics was carried out in secondary schools in Meru South Sub - County Kenya. The study lasted for four weeks which was relatively a short duration thereby controlling the effects of history and maturation. The researcher used systematic scoring key to control the effects associated with instrumentation. The advance organizers were given to those in experimental groups and those in control groups were taught using conventional methods.

The following are the major findings of the study: Pre-test analysis results revealed that the students were from similar groups before the implementation of the programme as reflected by the ANOVA test performed. Significant learning gains were achieved by students exposed to advance organizers as compared to those who were not. This is seen by the higher mean scores posted by the students in the experimental groups in the MCUAT.

CONCLUSION

The search for better teaching method led to this study on the use of A.O teaching strategy to teach mathematical concepts and skills on statistics on the topic they have not been taught before. The topic statistics in Form two is first introduced to secondary school students for the first time in the secondary school mathematics curriculum; therefore this study shows that the students' who were taught with advance organizers prior to the lesson did better than those who were just taught without the introduction of A.O teaching strategy.

Thus this study has provided some useful empirical evidence for the teaching and learning of the topics of the statistics. Mathematics teachers should be encouraged to use A.O to teach students topics they have not been taught before for improved conceptual understanding and retention of mathematics concepts. Based on the study findings, the following conclusions have been made: The use of advance organizer when properly implemented enhances students' conceptual understanding in mathematics more than the conventional methods.

RECOMMENDATIONS

Several educational researches have been carried out by science educators on how science students can achieve better in science and mathematics. The researcher recommends the following;

(i) The educational planners should make effort to give teachers assistance to get materials needed for A.O preparation.

(ii) The teachers should also be trained on how to improvise and prepare relevant advance organizers for their mathematics lessons as this study shows that they can improve achievement and retention of newly introduced concepts in mathematics.

(iii) Teacher trainers should include the use of advance organizers in both pre-service and in-service teacher education curriculum in Kenya.

(iv) Educational authorities should encourage teachers of mathematics to use advance organizers in their teaching and that the students should be given advance organizers in addition to good instructional methods and texts.

(v) Advance organizers should be given to students by teachers before the lessons since they are found to often have at least small facilitative effects for learners in most learning situations especially when it involves entire new learning.

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