The Effect of Integrating an Advance Organizer Model on Pupil Performance in the Learning of Circle Theorems by Grade 11 Learners

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Abstract
A major research domain in mathematics education is focused on the study of the effects of various types of teaching interventions aimed at helping learners improve their performance. This study investigated the effect of integrating an Advance Organiser Model (AOM) on pupil performance in the learning of circle theorems by grade 11 learners.The study used a quasi-experimental, non-equivalent control group design to compare achievement, motivation and attitude of learners being taught using an advance organiser model and those taught using traditional methods. The samples were all selected as intact classes from the same school in Kapiri Mposhi District at Kapiri Girls technical secondary school. The study was informed by the constructivist theory guided by the three phases of the AOM where learners in the experimental group were exposed to all the three stages of AOM which were (i) presentation of Advance Organiser (AO) (ii) presentation of learning task (ii) strengthening of cognitive organisers. The experimental group was exposed to the use of Advance Organiser Model while the control group was not exposed to AOM but learnt the topic through a traditional method mainly by lecture method. Findings of this study revealed that learners who learnt the topic of circle theorems using an AOM achieved higher than those who learnt the topic without it. There was also a significant difference in mean achievement scores between the two groups in favour of the experimental group of students instructed with AOM compared to those instructed with the traditional teaching method. The results from the questionnaire also indicated that the learners who learnt the topic using AOM where more motivated and recorded positive attitudes towards the mathematical topic under study through AOM.

Keywords: Integration of an Advance Organiser Model (IAOM); Constructivist theory; achievement, performance; motivation and attitude

1. INTRODUCTION

The subject of mathematics is one that offers great opportunity for concepts and proofs to be developed in other disciplines. For example, several concepts in physics make use of calculus which is derived from mathematics. For this reason and many other, mathematics has proven to be the cornerstone of almost all other subjects, hence the need to keep on finding better ways and strategies to be instructed to the learners for further understanding. The manner in which the subject content is delivered must be taken into consideration, for this reason, effective teaching of modern mathematics has been a matter of concern for educators as well as for teachers who find it difficult to present the concepts in mathematics.Among other things, mathematical literacy is essential for every child as it constitutes the core curriculum of several professional courses to be taught to a learner who will intern become more useful in the eyes of the society and problem solving aspect. Apart from mathematics being a problem solving tool, it is fascinating because of its opportunities for creation and discovery as well as for its utility. It involves conversion of abstract concepts into concrete form and bridges gaps between what exists in reality and its image in the mind of learner. It also develops the ability of induction, deduction and generalisation. (Walia, 2014).

Over the years in Zambia, the performance of learners in mathematics especially in their final examination results has been a source of concern. This worrisome picture can be seen from the following table depicting mean scores of learner's performance country-wide from 2013 to 2018.

Table 1.0: **(Grade 12 mean performance trend per year)**

YEAR	AVERAGE PERFORMANCE IN MATHEMATICS (%)
2013	26.50
2014	17.40
2015	17.40
2016	24.39
2017	28.29
2018	47.60

Source: (ECZ reports)

Research has proven thatsome of the contributing factor to poor performance of learners in mathematics include poor instructional strategies and poor retention abilities by learners as

supported by Anyor, (2017). An endeavour to improve the results in mathematics could be using different methods or strategies that will enable learners to learn the subject, understand it and improve in their performance. Hence the study was conducted.One of such instructional strategies which might have the potential to address the problems of effective teaching and learning of mathematical concepts could be through the integration of anadvance organiser model (Okey&Avwiri, 2014).

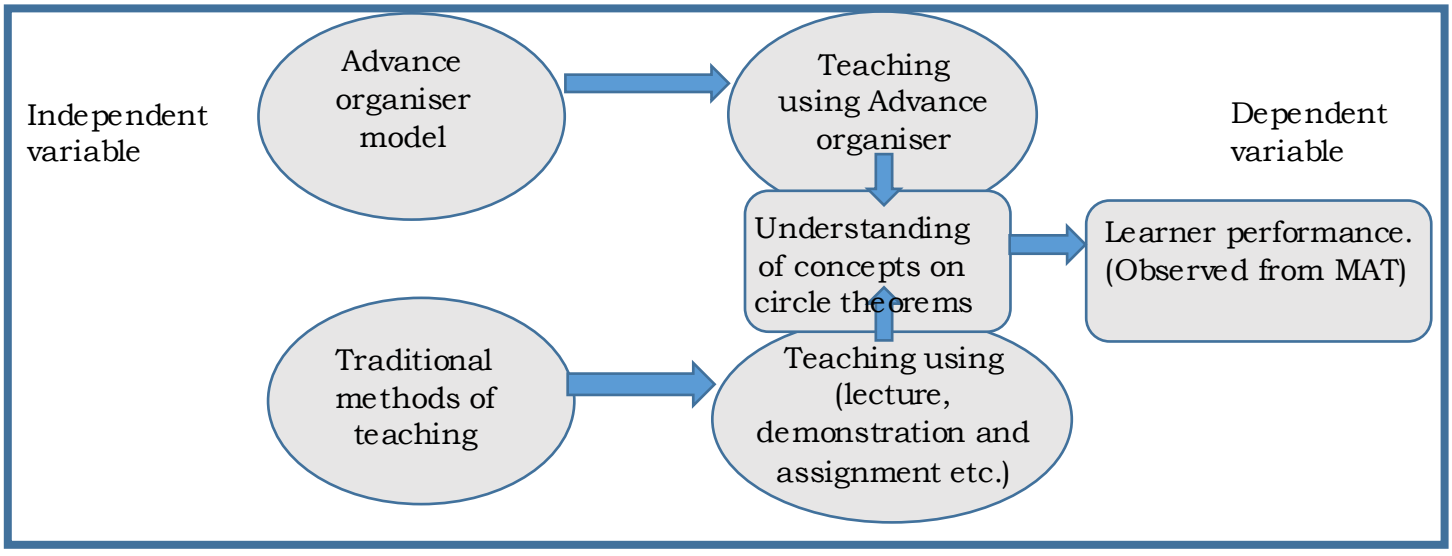
Several researchers have defined advance organiser differently but conveying a similar meaning. According to Ausubel (1963), the advance organizer is a strategy in which the teacher helps students to make connections between the prior knowledge and the new material. The advance organizer may be presented as written text, as graphics organizer, it may utilize audiovisual supports, or may be presented orally (Luten et al. 1980).

To Okigbo (2010), instructional strategies such as advance organisers have tremendous potentials in the teaching of abstract branches of mathematics such as algebra. This can also be extended to the teaching of circle theorems. The study therefore examined the efficacy of advance organiser model on learner performance in the learning of circle theorem.

Conceptual framework

The study looked at the effect of an advance organiser model in the teaching of mathematics specifically the topic of circle theorems. It then also look at the applicability of the model in improving the learning and understanding of concepts of circle theorems which was measured using performance in terms of achievement test of the learners in the topic. The dependent variable in this case was the learner performance while the independent variables included the impact of an advance organiser model in the teaching of circle theorems.

Figure 1.0 Conceptualised framework of the study



2. LITERATURE REVIEW

2.1 MODELS OF TEACHING

Several researchers have evaluated the term teaching as the act of helping leaners to learn well.Learners who are cognitively powerful have a wide range of strategies for acquiring knowledge. Therefore, Models of Teaching have been designed to impart to learners such strategies, which will help learners to think clearly and wisely and build social skills and commitment. They help students to acquire information, ideas, skills, values, and ways of thinking and means of expressing themselves in a nutshell. They are taught how to learn(Adriana & Laura 2010).

Models of Teaching include major philosophical and psychological orientations towards an aspect of teaching and learning. Each of the models of teaching has coherent theoretical bases (Joyce and Weil, 2009). The models approach to teaching was first described by Joyce and Weil (2009), who defined a model as a pattern or plan which can be used to shape a curriculum or course to select Instructional material and to guide teachers action.

Eggen (2010) defines Models as prescriptive teaching strategies designed to accomplish particular Instructional goals. Model differs from general teaching strategies because of this principle. General approaches to teaching are considered to be applicable to all teaching situations. But these Models of Teaching are not cure-alls or applicable to all teaching situations.

2.2 Advance Organiser Model (AOM)

In their research, Joyce and Weil (1980) developed several models which are grouped on the basis of their chief emphasis mainly about the way they approached educational goals and means. They classified the models into 4 families. These are information processing models; social interaction models, personal models; and behaviour modification models.

Information processing models share an orientation towards the information processing capability of students and the way they can improve their ability to master information. Under this family of models are the inductive thinking model, scientific inquiry model, inquiry training model, concept attainment model, cognitive growth model and the advance organizer model. Information processing models emphasise strategies that adopt our own natural curiosity and desire to make a sense of the world around us. These tools allow us to acquire and organize date, identify problems and generate solutions. The long-time goal of all information processing models is to teach students how to think effectively. Complex intellectual strategies allow students to absorb more concepts and information (Agashi, 2014).

An advance organiser is a kind of cognitive bridge, which teachers use to help learners make a link between what they know and what is to be learnt and 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 .Advance organisers are therefore frameworks that enable students learn new ideas or information and meaningfully link these ideas to the existing cognitive structure. (Shihusa&Keraro, 2009).

Advance Organiser modelin Education.

Advance organisers are used in almost all subjects in the teaching of concepts and skills. The study focused on the use of advance organizer model on learner performance in the teaching of circle theorems. It is therefore imperative that the use of advance organisers can also be view from a different perspective apart from its usefulness in mathematics.

Several studies have been conducted in the use of advance organiser in different fields or areas, researchers have tried to find if at all it has any positive effect on the phenomenon under study. One such study was conducted by Oloyede (2011). His study was focused on the effect of pictorial and written advance organisers on student's achievement in senior secondary school chemistry. In his study, the results showed that advance organisers enhanced the achievement and retention of the learning materials in chemistry by students. There was no significant difference between the achievement of male and female chemistry students taught with pictorial and written organisers. The study recommended that chemistry teachers should be encouraged to adopt pictorial advance organisers in teaching the concept of energy change in chemistry.

Another study by Shihusa and Keraro (2009) investigated the effect of using advance organisers on student's motivation to learn biology. The research design used was quasi-experimental design where the nonrandomized Solomon Four group was adopted. The focus was on the topic pollution. The findings indicated that students taught using advance organisers had a higher level of motivation than those taught using conventional teaching methods. The findings further indicated that male students had a significantly higher level of motivation than their female counterparts. This is yet another study that has shown a positive effect of the advance organizer and supported the research that was conducted study.

According to Mahanty (2016), in her study of trying to study the effectiveness of advance organizer model on achievement and on the development of motivation in social study. She found that advance organizer model has a significant role for the teaching strategy. She

further concluded that advance organizer model is more effective for development of advance study than traditional approach therefore it can be used as a teaching strategy in curriculum.

From the above studies in different several fields, it has been observed that if the advance organizer is nicely implemented, it can bring about positive effect in the phenomenon that is being investigated. Therefore in line with the investigation that was understudy, it was helpful to also test the model to ascertain if there was also a positive effect produced by the model.

Advance organizer model in teaching and learning of mathematics

Several studies have also been conducted in the field of mathematics concerning the impact of an advance organizer model to produce a change in the phenomena under study.

Amongst the many studies is one conducted by Ifamuyiwa (2011) from his study, he found that the students exposed to the experimental intervention significantly achieved better than those in the control class at their comprehension level of cognition. This finding has again revealed the efficacy of the use of advance organizer in enhancing students' achievement in mathematics.

On a contrary, the study conducted by Montgomery (2013) showed that there was no significant difference between the effects of availability of mathematics textbooks, mathematics laboratory; and availability of teaching/learning resources on students' academic performance in mathematics when considered as advance organisers.

Another study was conducted by Anyor (2017), the findings of the study revealed that students taught with advance organisers retained significantly higher than their counterpart taught without advance organisers. The study also revealed that there was no significant difference in the mean retention scores of male and female students taught mathematics with advance organisers. The study recommends that the mathematics curriculum should incorporate advance organisers as a teaching strategy in secondary schools. Also, mathematics teachers should be trained on how to integrate advance organisers in teaching through Seminars (Anyor, 2017).

Advance organizer model in the teaching of circle theorem

From the review of literature above, it has been observed that advance organizer model has been used to study its effect on different phenomenon but little has been done on studying its effect on a single mathematics topic especially on circle theorem. Therefore, the focus of the study was to investigate the effect of advance organizer model on learner performance in the teaching of circle theorems. In trying to do so, the researcher made relevant comparison to the literature that has been reviewed.

3. METHODOLOGY

The design for the study was a quasi-experimental design. Specifically, it was a non-randomized pre-test post-test control group design. This design was considered for the study because the subjects in the sample were not randomly selected since they were given treatment in their intact classes to avoid disruption of the schools schedules during the experimental period (Ali, 2006).

The quasi experimental design involved non-random assignment of participants into two groups being experimental and control group. The two groups were then subjected to a pre-test to ascertain the homogeneity of the knowledge level of the two groups on the topic under study. The study then compared the performance of the two groups after administering a treatment to an experimental group which was learning circle theorems using the advance organiser model and the control group learning using traditional methods such as teacher demonstration, group work, assignment question and answer and also the use of charts as teaching aids.

The pre-test in terms of a Mathematical Achievement Test (MAT) was administered to the two groups. For the post test, the same MAT was administered to the two groups but with the same questions being shuffled.

Respondents in the study were drawn from the intact grade 11 classes with total number of 78 learners. (Ted, 2013). From the three classes, two classes were purposefully selected because among the three classes, one of them learn pure sciences and was constituted through administration of an aptitude test and they happened to score the highest, therefore could not be incorporated in the study as respondents especially for achievement tests. The remaining two classes made a total of 62 learners. Hence 62 learners were taken as the sample size from the school.

Data was collected using two research instruments namely Mathematics Achievement Test (MAT) and a partitioned five point Likert scale questionnaire answering two research questions so that the data can constitute more meaning by using different data sources of the research information (Creswell, 2009).

An achievement Test was administered to the two groups of learners which included the pre-test to make sure they were on the same knowledge level and the post-test to test if the treatment had a significant impact on the learner performance.The pre-test and post-tests were equivalent only that in the post test, the questions were shuffled. For the achievement Test and the questionnaire, the instruments used were constructed by Chimuka (2017) in his

research and have already been validated and their reliability has been certified.A questionnaire for learners was used to collect data relating to students attitudes of learners towards learning of circle theorems after the treatment. The questionnaire was also used to examine the motivation of learners after the treatment was administered to the learners. The response mode was a five point Likert scale of measurement.

In order to ascertain the content and construct validity of the instrument for the study, the researcher ensured that the questionnaire covered the research questions of the study and then subjected the initial draft to peer scrutiny and also three experts and the project supervisor also to make necessary corrections and give advice to what could be changed or retained.

3.1 Data Collection Procedure

The researcher prepared sixty two (62) questionnaires. The 62 questionnaires were distributed to the learners from the two respective classes at the school. Administering of the questionnaires were conducted by the researcher.A pre-test in form of an achievement test was administered to the two grade 11 classes comprising of the control and experimental group to assess the learner's cognitive levels on the topic of circle theorem. The same pre-test was used as a post-test with shuffled questions. Before conducting the research, the researcher had to seek for permission from relevant authority at district level and also at school level as shown on the appendix.

Mixed methods of analyzing data were employed. Quantitative data from questionnaires and Achievement Test were analyzed with the assistance of a Statistical Package for Social Sciences (SPSS). The data for the Achievement Test was tested for normality as a required assumption for the student T-test.

4. FINDINGS

A pre-test was administered to both groups (control and experimental groups) two weeks before the interventions in order to check whether the two groups were of comparable abilities in the topic of circle theorems before the interventions while the post test was administered at the end of the intervention. Table 4.1 shows the descriptive statistics for both the Pre-test and Post-test results for the two groups.

Table 2.0: Group Statistics for Pre-test and Post-test

Achievement Test	Group	N	Mean	Std Deviation	Std Error Mean
Pre-test	Experimental	24	8.08	6.290	1.284
	Control	38	8.45	5.500	.892
Post- test	Experimental	24	65.00	27.819	5.679
	Control	38	35.03	24.562	3.984

Source: (field data, 2019)

For the experimental group in the pre-test as shown in table 2.0, the average mark (M = 8.08; SD = 6.29) was slightly higher than the control group average mark (M = 8.45; SD = 5.50) while in the post-test results,the experimental group post-test average (M = 65.00; SD = 27.819), was higher than that of the control group post-test average (M = 35.03; SD = 24.562). To check if the difference between the achievements of the groups were statistically significant, independent samples t-test was computed for both the pre-test and post-test.

The followingfour hypothesis were tested at 95% confidence interval for the pre-test:

Null hypothesis (H0): There is no statistically significant difference in understanding circle theorem concepts between the experimental group and control group.

Alternative hypothesis (H1): There is statistically significant difference in understanding circle theorem concepts between the experimental group and control group.

Null hypothesis(H_0): There is no statistically significant difference in achievement scores between learners exposed to advance organiser model and those not exposed to it

Alternative hypothesis(H_1): There is a statistically significant difference in achievement scores between learners exposed to advance organiser model and those not exposed to it.

Table 3.0: Independent samples t-test of pre-test and post-test achievement.

GROUP	F	Sig	t	df	Sig(P-value)
Pre-test	.334	.566	-.240	60	.811
Post-test	.881	.352	4.446	60	.000

Source: (field data, 2019)

Table 3.0 shows that for the pre-test, there was no statistically significant difference in the scores for the experimental group (M = 8.08; SD = 6.29) and that of the control group being (M = 8.45; SD = 5.50).[t (60) = -0.240; p = 0.811)]. These results of the pre-test confirmed that the two groups (experimental and control) were of comparable and similar understanding

ability of circle theorem concepts before treatment ($p > 0.05$); as such, any differences in understanding abilities of circle theorems after treatment could be attributed to the treatment which is the AOM.

Table 3.0 further shows that there is a statistically significant difference in achievement (post-test marks) of experimental group (M =65.00; SD = 27.819) and control group (M =35.03; SD =24.562); t (45) = 4.45; p = 0.00). Therefore we can conclude that AOM are effective ($p < 0.05$) in improving the performance of learners.

4.1 Results on the effect of AOM on learner motivation

The five attributes of motivation that were investigated were;

(i) Participation during lesson delivery,

(ii) Concentration during lesson delivery,

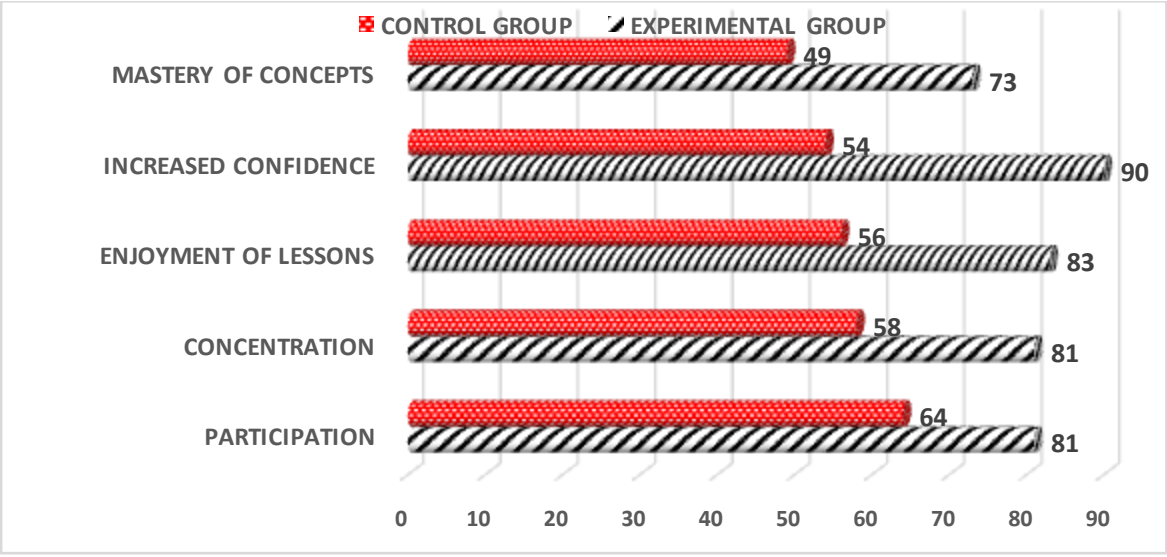
(iii) Enjoyment of class lessons,

(iv) Self-confidence, and

(v) Content mastery.

Statistical significance was tested through the independent t-test of the motivation attributes at 0.05 significance level.

Figure 2.0: Chart showing the attributes of motivation in percentages.



(SOURCE: FIELD DATA 2019)

Figure 2.0 arises from the responses from the questionnaire item "I was able to master the content after learning in my class" for experimental and control group. The experimental group which was exposed to the AOM developed more mastering skills in class as can be

seen from the 73% as compared to those who were not exposed to the AOM who had 49%. It can therefore be concluded that, AOM improves the mastering skills of learners in the classroom.

The figure also represents the responses from the questionnaire item "The teaching/learning strategy increased self-confidence in me" .From the above figure, it can also be seen that the experimental group which was exposed to the AOM had more confidence in problem solving in class as can be seen from the 90% as compared to those who were not exposed to the AOM who had 54%. From figure 2.0, it can be seen that AOM increases learner confidence.

Figure 2.0 also shows the representation of the responses from the questionnaire item "I enjoyed the lesson(s) because of the teaching strategy"?The above figure shows that the experimental group which was exposed to the AOM recorded higher enjoyment levels in class as can be seen from the 83% as compared to those who were not exposed to the AOM who had 56%. This arises from the respondents from the questionnaire item "I enjoyed the lesson(s) because of the teaching strategy". It can therefore be concluded that AOM leads to enjoyment of lessons. There was also an observation that the experimental group which was exposed to the AOM had higher concentration levels in class as can be seen from the 81% as compared to those who were not exposed to the AOM who had 58%. It can therefore be concluded that AOM improves learner concentration in the classroom especially in mathematics.

From the above figure 2.0, it can be seen that the experimental group which was exposed to the AOM was encouraged more to participate in class as can be seen from the 81% as compared to those who were not exposed to the AOM who had 64%. Therefore, we can conclude that AOM improves the level of learner participation in the classroom.

4.2 Results On Attitude Of Learners Between Experimental And Control Group After Learning Circle Theorem Using AOM And Traditional Methods.

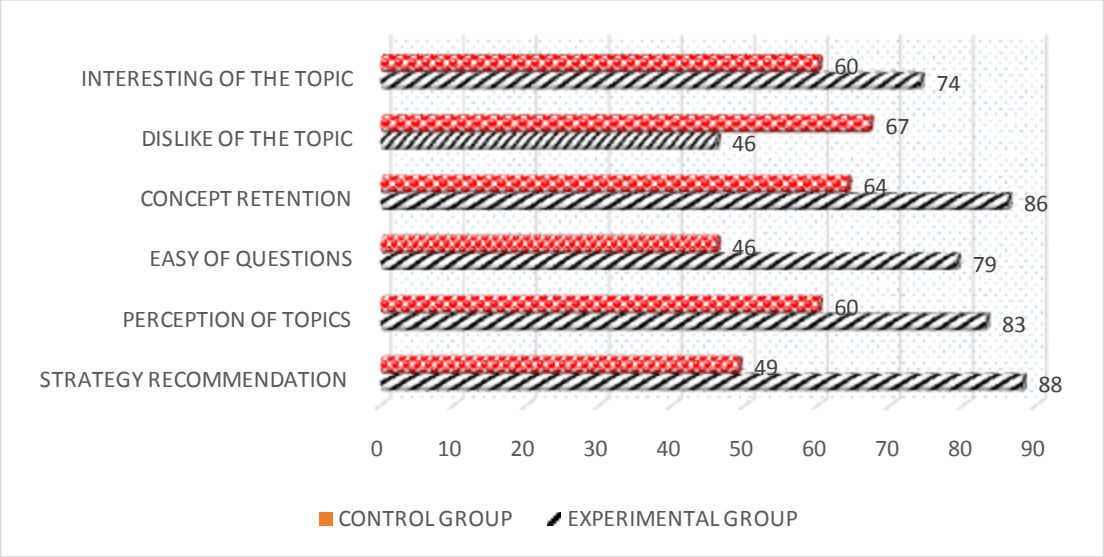
To answer the third question**,** some of thesix attributes of attitudes were used to investigate whether the students attitudes were positively or negatively affected by the teaching and learning method used in their respective classes. The six attributes of attitudes were used in the study to test the teaching strategy were as follows.

i) Interesting of the topic
ii) Dislike of the topic
iii) Concept retention
iv) Easy of questions

v) Perception of the topic

vi) Strategy recommendation.

Figure 3.0chart showing the attributes of attitudes in percentages.



(SOURCE: FIELD DATA 2019)

Figure 3.0 represent the responses obtained from the item "I am more interested to study other related topics after learning circle theorem' From the above figure, it can be seen that the experimental group which was exposed to the AOM was more interested to learn the related topics as compared to those who were not exposed to it. This can be seen from the 74% of the experimental group and 60% of the control group. It can therefore be concluded that AOM makes topics to be very interesting.

From the responses obtained from the respondents on the questionnaire item "I never liked the topic circle theorem before it was taught". Figure 3.0, it can be seen that the experimental group which was exposed to the AOM had less leaners hating the subject after being taught using the AOM as depicted by 46%. The control group had a higher percentage of 67% of learners who hated the topic even after learning using the traditional method. From figure 3.0, we can therefore conclude that AOM makes learners to like the topic being taught. Hence the experimental group liked the topic more as compared to the control group. We can therefore direct the hatred of the topic from the control group towards the type of teaching strategy which was used in the class room as compared to the one which was used the classroom for the lessons.

From figure 3.0, it can also be seen that the experimental group which was exposed to the AOM were able to retain more concepts as compared to those who were not exposed. The figure 3.0 represents the responses from respondents from the questionnaire item "I forget the taught concepts on the topic easily because of how it was taught". This can be clearly seen from 86% from the learners who were exposed to the AOM as compared to those who were not exposed to the teaching strategy using the AOM as seen from the 64%. It can therefore be concluded that AOM improves concepts retention in lessons of mathematics especially the lessons on circle theorem.

From the above figure, it can be seen that the experimental group which was exposed to the AOM found the questions on circle theorems to be easy as compared to those who were not taught using AOM. This is as a result of learner responses to the questionnaire item "I am now able to answer questions on circle theorem without much difficulty after being taught using the teaching strategy". This can be clearly seen from 74% from the learners who were exposed to the AOM as compared to those who were not exposed to the teaching strategy using the AOM as seen from the 46%. A conclusion can therefore be made that AOM makes problems on circle theorem to be easy to the learners.

From the above figure 3.0, it can be seen that the experimental group which was exposed to the AOM had higher perception in terms of understanding the topic. This can be clearly seen from 83% from the learners who were exposed to the AOM as compared to those who were not exposed to the teaching strategy using the AOM as seen from the 60%. It can therefore be concluded that AOM changes learner perception from negative to positive.

The learners from both the experimental and control group were asked to respond to the questionnaire item "I would recommend the use of the teaching/learning strategy used in my class for future geometry lessons." Their responses in terms of percentage were as follows, from the experimental group, 88% of the learners recommended the use of the teaching strategy as for future geometry lessons while 49% of the learners recommended the use of the teaching strategy for future geometry questions in the control group. Therefore, it can be concluded that, the teaching strategy in the experimental group which is learning using an advance organiser model prepares learners to be ready for future mathematical related topics in mathematics.

4.3DISCUSSION

This section discusses the three main findings of the study, the main findings were as follows; the impact of Advance Organiser model on learner performance, motivation and attitudes.

From the results obtained using the analysis of t-test on performance of learners taught using an advance organiser model and those taught using a traditional or conventional method or strategy, there was a significant difference in achievement in favour of the learners who were taught using AOM as compared to those who were not exposed to it. The learners who were exposed to the model achieved higher average scores as compared to the learners who were not exposed to the model in the control group. This is also in line with the investigation conducted by Rajendra (2012) whose results indicated that learners who were taught using advance organiser model retained higher than there counterpart who were taught using traditional methods.

The possible reasons could be that the learners in the experimental group were able to interact with information and effectively remember what they have been exposed to in the foundational knowledge before the new information was taught. In this regard, the learners created a foundation were the new information was to be built on.

In addition, the learners were able to be directed on what is important in the coming lesson in the experimental group as compared to those who were in the control group were the learners were taught using the usual conventional way of not relating the information or material that they were going to learn to the previously learnt materials or what they already know.

The learners also in the experimental group were able to attain higher achievement in terms of performance as the method used to teach the lesson improved their mastering of the concepts learnt in the classroom as compared to those in the control group who attained significantly low in terms of achievement as their level of mastery was less.

The learners in the experimental group also displayed higher achievement as compared to those in the control group. This is because the learner's motivation was statistically significantly different in terms of mean scores in favour of the experimental group as seen in table 4.5. According Sevil O (2017) motivated students in the classroom are able to perform better in terms of achievement as compared to learners who are not very motivated.

Apart from improved achievement of learners when taught using AOM, it was also observed that the learners in the experimental group had their motivation levels increased as compared to those in the control group. In this regard, advance organisers tend to increase learner motivation. This observation can also be made concrete by another investigation conducted

by Oloyede (2011). In his findings, he concluded that advance organisers enhance retention of learning materials.

The findings of this study are also in line with a study conducted by Walia (2014) in trying to investigate the effect of integrated Syntax of Advance Organizer Model and Inductive Thinking Model on Attitude towards Mathematics and Reaction towards Integration of Models which reveals that, in terms of attitudes, the experimental group was found to have attained higher attitude scores as compared to the control group. Therefore, the learners have increased positive attitude towards the topic and the subject of mathematics itself. It was also observed from the findings of the study that learners who were exposed to learning using an advance organiser model performed relatively much better than those who were taught using the conventional or traditional method.

From this study, it has also been observed that teaching and learning using advance organiser model not only has a positive effect on learner performance through higher achievement but also has a positive impact on learner motivation and other attributed of attitudes of learners. Some examples that had improved in the study though motivation where; learner concentration, participation, mastering of content, self-confidence and enjoyment of the topic. It was also observed that AOM had a positive attitude on experimental group towards the learning of circle theorem. The attributes of attitudes that where improved in terms of attitudes were; strategy recommendation, topic perception, easy of questions, concept retention, interest in the topic and likeness of the topic. These were a few attributes that were being investigated in this study.

5.0 SUMMARY OF FINDINGS

The results of this study were analysed according to the research question.

5.1 Research question one

What is the impact of an advance organiser model in the teaching of circle theorems on learner performance? The independent samples t-test (table 4.4) shows that there was a statistically significant difference in the mean marks of the experimental group (M =65.00; SD = 27.819) and control group (M =35.03; SD =24.562); t (45) = 4.45; p = 0.00). Since ($p < 0.05$) we can therefore conclude that advance organiser model enhances pupils' positive attitudes towards the learning of circle theorem.

5.2 Research question two

Does advance organiser model improve the levels of motivation of learners in circle theorems? For this question, descriptive data was analysed from the questionnaire according to the motivation attributes the results were that those learners who learnt using an advance organiser model had higher concentration, participation, lesson enjoyment, confidence levels to solve questions and mastery of learnt concepts.

5.3 Research question three

How does the attitudes of learners differ between learners exposed to the advance organiser model and those who were not exposed to it? For this question, descriptive data was analysed from the questionnaire according to the attitude attributes, the results were that those learners who learnt using an advance organiser model had positive attitudes towards strategy recommendation, topic perception, easy of questions, concept retention, found the topic likable and recorded more interest in the topic as compared to the control group.

5.4 Concluding Remarks

From the findings of the study, it can be concluded that learning of mathematical concepts especially concepts on circle theorem using AOM improves student's performance as seen from their achievement scores and analysis. It can be further stressed that learning through AOM helps learners to achieve high as it prepares them to be ready form the new material or information to be learnt. Apart from that, AOM also improves learner motivation which is cardinal in the effective retention of learnt concepts by learner.

Motivation is the key determinant of student achievement; hence any teaching and learning method that motivates learners to learn will go a long way in solving the Zambian learner's problem of poor achievement in circle theorem and consequently improves general results or achievement in mathematics.

While AOM improves learner performance, it also changes the poor attitudes that learners have towards the learning of mathematics as it changes pupil's perception towards the lesson. It also improves learner interest to learn the subject and also helps learners to retain the learnt concepts.

5.5 Recommendations

1. The teaching strategy seems not to be common to learners, the policy makers and implementers starting from the school head of departments should consider revisiting the strategy for its potential to produce higher achievement in relation to learner performance.

2. The teaching strategy should also be used to instruct other topics to learners as it results have shown significant improvement of not only in achievement but also in learner motivation and attitudes towards the subject and the topic being learnt.
3. For the teaching strategy to produce significant results, the learners should be actively participating and willing to be part of the lesson's activities.
4. The study should also be investigated on the other samples for example samples including both girls and boys to check its effectiveness on gender.
5. In trying to make the strategy more effective by teachers, it should be incorporated as part of the school based continuing professional development.

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