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"EFFECT OF INSTRUCTIONAL STRATEGIES ON STUDENTS' ATTITUDE DEVELOPMENT TOWARDS MATHEMATICS IN MUMIAS SUB-COUNTY"

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Abstract

The purpose of this study was to determine the effect of instructional strategies on students' attitude development towards mathematics. Mathematics is a key subject which students cannot avoid if they have to lead a bright future. Despite the introduction and implementation of different teaching methods and motivations, the achievement of students in mathematics at school level has persistently been poor, hence the need to explore the effect of instructional strategies on students attitude development towards mathematics. This entails the use of Behavioral Objective- Based (BOB), Peer Instruction enriched with Concept Tests (PICT), both BOB and PICT (BO-PICT) and Conventional Instruction (TI). The theoretical framework was guided by social constructivism theory. It adopted quasi-experimental, utilizing pretest posttest non-equivalent group design. The target population was 3056 form three students in the 38 secondary schools. Disproportionate stratified sampling and simple random sampling was used to select 327 students. Mathematics Achievement Test (MAT) was used to collect data. Data was analyzed using both descriptive and inferential statistics. Behavioral Objective-Base (BOB), Peer Instruction enriched with Concept Tests (PICT) and both BOB and PICT, (BO-PICT) promoted students' attitudes and motivation towards the learning of mathematics. There was there was no significant difference between Experimental groups and the Control group in the SAQ pre- test examination. BOB, PICT and BO- PICT had positive influence on students' achievement in mathematics.

Key Words: Instructional strategies, attitude development, mathematics

1. Introduction

According to National Council of Teachers of Mathematics (NCTM, 2000) mathematics is at the heart of many successful careers and successful lives. It is as a model of thinking (lji, 2008), which encourages learners to observe, reflect and reason logically about a problem and in communicating ideas making it the central intellectual discipline and a vital tool in science, commerce and technology (Imoko and Agwagah, 2006). "Mathematics is a precursor of scientific discoveries and inventions" (Salman, 2005). It is the foundation of any meaningful scientific endeavor and any nation that must develop in science and technology must have a strong mathematical foundation for its youths. Hersh (1986) defines mathematics as ideas not as marks made with pencils or chalk, not physical triangles or physical sets).

It is argued that competence in mathematics better prepares young people for their numeracy demands of modern work places and raise the overall skills levels of the work force (KIE,2002). It may help in improving access for larger numbers of young people to post school education and training. Despite the recognition accorded to mathematics due to its relevance since the ancient period, Elekwa (2010), students exhibit non-chalant attitude towards mathematics, even when they know that they need it to forge ahead in their studies and in life.

Analysis indicates that Students' performances in mathematics are consistently poor (Kenya National Examination Council (KNEC), 2008). The reasons given are that mathematics is highly abstract; the mode of instruction remains overwhelmingly teacher-centered (Butty 2001), teaching and learning of mathematics is a complex activity , achieving improvement in mathematics teaching and learning requires seeing mathematics as multidimensional-including both procedures as concepts, as well as strategies, ways of reasoning, and attitudes and dispositions (Kilpatrick, Swafford and Findel, 1991).

Researchers emphasize the need to develop students' understanding of mathematical connections among topics, across representations, and between contextualized and decontextualized settings. Developing these connections often requires more attention to mathematical discussion and argumentation in the opportunity to struggle with challenging mathematics (Hiebert and Grows, 2007). It also requires students to explore and engage with challenging mathematics, for example by managing the cognitive load (Chandler and Sweller, 1991) and enabling a more interactive, exploratory path into difficult mathematics (Kaput et al, 2007).

Improving mathematics teaching and learning is the most important challenge facing educators worldwide. There have been strong calls for change in mathematics education, and in particular for change in classroom practices. Teachers have been forced to organize instruction so that students participate in more collaborative, discussion – based activities with an eye to supporting a community of learners, rather than a set of individuals working on mathematics (NCTM, 1991). This has proven to be very challenging (Ball, 1993).

Teaching of mathematics is concerned with computational know-how of the subject, selection of the content, communication and application. While teaching mathematics one should use the teaching methods, strategies and pedagogic resources that are much more fruitful in gaining adequate responses from the students than we have ever had in the past.

The teacher is the most indispensable factor in effective administration of any education system. The role of teachers at all levels of education is emphasized that no educational system may rise above the quality of its teachers. This underscores the need for teachers' effectiveness in teaching and learning (Mitzel, 1960). It is the teachers' competence, ability, resourcefulness, and ingenuity through effective utilization of appropriate language, methodology and available instructional materials that could bring out the best from the learners in terms of academic achievement.

Porter and Brophy (1988) say that student learning can be improved only if teachers' practices are of high standard; something many teachers are not prepared to do. Professional development for teachers could serve to fill the gap between standards-based reform and pre-service teacher preparations (Birman et al., 2000). Unfortunately, teacher training does not adequately prepare them for the rigors of standards-based student achievement (Corcoran, 1995; Darling-Hammond, 1996; Hiebert,1999; Little 1993; Sparks & Loucks-Horsley, 1989).

No single factor is sufficient to change mathematics education (Roschelle and Singleton, 2008). Powerful new representations only increase student understanding if teachers engage students in probing the meaning of the representations. Likewise, a change in the teacher – student interaction (such as a teacher giving students more responsibility to solve challenging mathematics problems), can be supported by giving students new tools, for example, a new tool that enables exploration of a mathematical construct in terms of actions and consequences (Bransford, Brophy and Williams, 2000). Of course, aligned and sustained teacher professional development is essential to such instructional change (Wei, Darling-Hammond, Andree, Richardson and Ophanos, 2009).

Studies have shown just how thin many teachers' knowledge is. They cannot achieve reasonable standards of mathematical proficiency with most of the students, as they become nation's adults. The usual solution is to require teachers to study more mathematics. Many propose additional coursework for teachers, and some argue that elementary teachers should be specialists. But increasing the quantity of teachers' mathematics coursework will only improve the quality of mathematics teaching if teachers learn mathematics in ways that make a difference for the skill with which they are able to do their work. The goal is not to produce teachers who know more mathematics. The goal is to improve students' learning. Teachers' opportunities to learn must equip them with the mathematical knowledge and skill that will enable them to teach mathematics effectively.

Most schools in Mumias sub-county are well equipped given that Mumias Sugar Company sponsor most of them through its cooperate social responsibility and outreach programs. In spite this, students' performance in mathematics is still wanting - pulling the sub-county's KCSE mean grade in the negative direction (Mumias District Examination Analysis, 2008).

There are areas of mathematics that pose problems to learners in the secondary school mathematics syllabus. These include Compound Proportion and Rates of work, probability, linear programming and Latitudes and Longitudes, among others. Although these areas pose challenges to students, they are very important because they are examined every year in the Kenya Certificate of Secondary Education (KNEC, 2007). The instructional Practices used in the study are Behavioral Objective-Based (BOB), Peer Instruction enriched with Concept Tests (PICT), both BOB and PICT (BO-PICT) and conventional method (TI). BOB, PICT and BO-PICT are interactive methods of learning just like Cooperative Learning, Collaborative Learning, Group-Based Learning Project –Based Learning and Problem-Based Learning among others. To improve mathematics education and ameliorate most of the ineffectiveness in the schooling process, use of effective instructional practices is needed. It is thus necessary to assess the influence of instructional practices on students' achievement in mathematics.

1.1 Statement Of The Problem

Almost the entire mathematics course in Kenya is designed to enable the learners acquire attitudes and knowledge that will be relevant to students' life after school-fostering a positive attitude towards appreciating the usefulness and relevance of mathematics to a modern society.

Strengthening of Mathematics and Science in Secondary Schools Education (SMASSE) in-service program was introduced in 2005 to encourage teachers to use instructional approaches that could help improve students' performance in mathematics. African Mathematics Initiative (AMI) which was formed in 2011 by lecturers and post graduate students at Maseno University in response to the success of Maseno Mathematics Camp was to enable secondary school students to experience mathematics in an enjoyable and relevant way. However, performance of students in mathematics continues to decline.

Classrooms are often composed of students from different backgrounds, with different levels of motivation and are also of a wide ability range. This poses challenges to the teacher and calls for a variety of methods and approaches to teaching.

Teachers often state behavioral objectives in their lesson notes when preparing to teach and tell students to use group work when discussing some of the questions. They however fail to realize that behavioral objectives and cooperative group work could better be utilized to stimulate the learners for possible better outcomes. The study was to determine the effect of instructional strategies on students' attitude development towards mathematics.

1.2 Objectives

To determine the effect of instructional strategies on students' attitude development towards mathematics.

1.3 Hypotheses

HO_2: There is no significant difference between attitude scores of students taught Compound proportion and rates of work by BOB, PICT, and BO- PICT and those taught by conventional method.

2. Literature Review

2.1 Instructional Practices And Students' Attitude Towards Mathematics

Definitions of attitude towards mathematics are numerous as researchers' and thinkers' conceptions, ideas and perspectives vary. According to a point of view, the attitude towards mathematics is just a positive or negative disposition toward mathematics (Zan and Martino, 2007). Considering attitudes towards mathematics from a multidimensional point they define an individual's attitude towards mathematics as a more complex way by the emotion that he/ she associates with mathematics, his/her beliefs towards mathematics, which could be either positive or negative and how he/ she behaves towards mathematics. Research on attitude in mathematics education has been motivated by the belief that something called 'attitude' plays a crucial role in learning mathematics but the goal of highlighting a connection between positive attitude and mathematics achievement has not been reached conclusively (Zan & Martino, 2007). It is therefore imperative to continue to search for linkages between instructional methods that could facilitate the development of more positive attitude towards the learning of mathematics, hence this research.

It is generally believed that students' attitude towards a subject determines their success in that subject. In other words, favorable attitude result to good achievement in a subject. A student's constant failure in a school subject and mathematics in particular can make him to believe he can never do well on the subject thus accepting defeat. On the other hand, his successful experience can make him to develop a positive attitude towards learning the subject. This suggests that student's attitude towards mathematics could be enhanced through effective teaching strategies. It has in fact been confirmed that effective teaching strategies can create positive attitude on students towards school subjects Bekee(1987), Balogum and Olarewaju (1992), Akinsola (1994), Akale (1997) and Olowajaiye (1999) and (2000).

Attitudes are psychological constructs theorized to be composed of emotional, cognitive and behavioral components. Attitudes serve as functions including social expressions value expressive utilitarian and defensive functions, for people who hold them (Newbill, 2005). To change attitudes the new attitudes must serve the same function as the old one. Instructional design can create instructional environments to effect attitude change. In the greater realm of psychology, attitudes are typical classified with affective domain, and are part of the larger concept of motivation (Greenwald, 1989d). Attitudes are connected to Bandura's (1997) social cognitive learning theory as one of the personal factors that affect learning (Newbill, 2005).

The definition of attitude depends on the purpose of the definition. Most attitudes researches include the concept of evaluation as the basis of definition. To Petty and Cacioppo (1986) attitudes are general evaluations that people hold in regard for themselves, other people, object and issues. To Greenwald (1989b), attitudes are pervasive, predict behaviors, are a force in perception and memory, and they serve various psychological functions. Though there is an ongoing debate about the structure of attitudes (Newbill, 2005), however instructional designers have long assumed that attitudes is made up of three components; a cognitive component, an emotional component and a behavioral component (Bednar and Levie, 1993). The debate of the existence of the component structure of attitude may never be completely resolved because attitudes are constructs and are therefore not directly observable

(Newbill, 2005). The measurement of attitude is inextricably tangled with theoretical debate on the nature of attitudes.

Social psychology has notice that people respond to objects (ideas) with different degrees of positive to negative evaluations. Responses could be affective (e.g... frowning or smiling); cognitive (e.g.… stating rational thoughts) or behavioral (e.g. clapping or running away). Social psychologists conceived of a driving force behind these responses, and name it- attitude. They proceeded to measure by measuring what they conceived to be the effects of it. It is important to note that all responses are technically behaviors (Ajzen, 1989). He also noted that attitudes are functions of beliefs; hence it cannot be discussed in isolation from beliefs. He argues that beliefs about an attribute of an object contribute to the attitude towards the object. Therefore according to him, beliefs about mathematics may directly affect the attitude formed about mathematics.

In addition to beliefs influencing attitudes, a person's beliefs and attitudes towards mathematics can also influence the way they behave towards the subject. The relationship between beliefs, attitudes and behavior can be understood through Ajzen and Fishbein's (1975) theory of reasoned action (figure 2.1). For example, students with positive attitudes and who believe that participating in a mathematics experience will develop their skills, may engage in mathematics experiences. In contrast, students with negative attitudes and who believe that participating in a mathematics experience has no value may avoid engaging in mathematics experiences.

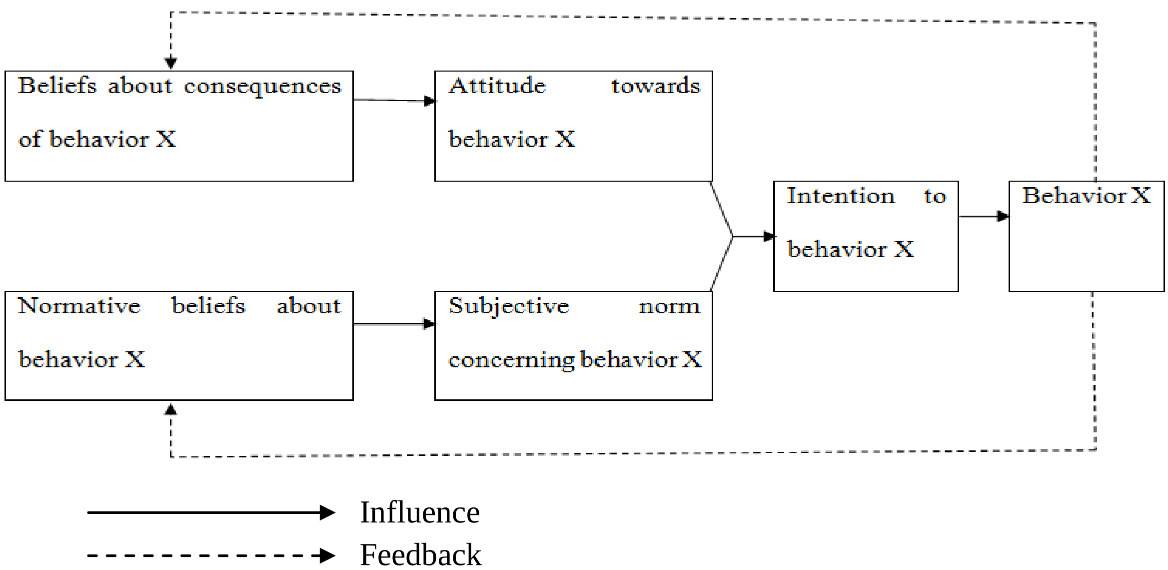

Figure 2.1: Theory of reasoned action (Ajzen & Fishbein, 1975)

The theory of Reasoned Action (Ajzen & Fishbein, 1975) represents beliefs as being the fundamental building blocks of attitudes. The first phase of the theory begins with a person being presented with the decision of whether or not to perform a behavior. The second phase of the model involves the activation of a person's attitude towards the behavior which then leads to a person's intention to perform the behavior and finally to the enacting or rejecting of the behavior.

Uusimaki, (2004) & Wilkins, (2002) remarked that teachers' attitudes towards mathematics may influence the teaching methods they adopt in the classroom and this in turn affects students' attitudes towards mathematics and ultimately their achievement.

Several studies in the area of mathematics have shown that instruction, especially at the secondary school level remains overwhelmingly teacher-centered, with greater emphasis being placed on lecturing and textbook than on helping students to think critically across subject area and applying their knowledge to real- life situation (Butty, 2001). There is need to adopt some of the recent reform-based instructional strategies, along with some traditional practices that have been overlooked and underutilized in secondary mathematics (NCTM, 2000). Such practices include individual exploration, peer interaction and small group work each of which emphasizes the use of multiple approaches to problem solving, active student inquiry and the importance of linking mathematics to students' daily life (Butty, 2000). A key component in reform is the movement from traditional to reform instructional practices in mathematics and the importance of examining the effects and relationship among types of instructional practices that students receive and their resulting achievement and attitudes towards mathematics. Studies related to instructional practices and academic achievement have suggested that the quality of teachers' instructional messages affects children's task, involvement and subsequent learning in mathematics (Cornel, 1999, Butty, 2001). The National Council of Teacher of Mathematics (NCTM, 2000) has advocated for the development of inquiry-based mathematics tradition.

According to Fennema, Carpenter and Peterson (1989), students are encouraged to explore, develop conjectures, prove and solve problem. The assumption is that students learn best when they resolve problematic situations that challenge them through conceptual understanding. In the study by Stein, Grover and Henninnssen (1996) investigated the use of enhanced instructions as a means of building student capacity for mathematics thinking and reasoning concluded that students must first be provided with opportunities, encouragement and assistance before they can engage in thinking, reasoning and sense making in mathematics classroom. Consistent engagement in such thinking practices, they maintained, should lead students to a deeper understanding of mathematics as well as increased ability to demonstrate complex problem solving, reasoning and communication skills upon assessment of learning outcomes. They concluded that the tasks used in mathematics classroom highly influence the kinds of thinking processes students employ, which in turn influence learning outcomes. Perhaps this is the reason why objective- based with small group work in mathematics classroom becomes relevant.

It is therefore imperative for teachers to appreciate and inculcate in students positive attitudes towards mathematics by using improved and appreciate instructional strategy. It is believed that the lack of specific directives has one way or the other hindered learning achievement among students.

However behavioral objectives when properly formulated and communicated to students with use of small group work could function to remedy the problem of effective teaching and learning of mathematics. The knowledge of behavioral objectives can be useful in indicating to the learner what is actually required of them instead of wondering over the learning materials and as a result relevant learning achievement and attitude are promoted. Mager (1962) popularized the use of behavioral objectives in his class on preparing instructional objectives. According to him if a learner is provided with a copy of behavioral objectives the learner does less work. Meldon (1978) had supported the use of behavioral objectives by pointing out that they clearly indicate to students what is required of them and as a result relevant learning enhanced. He argued that behavioral objectives and small group work are very much similar in that one directs another.

Nzewi (1994) noted that teachers should no longer be satisfied with only having a statement of behavioral objectives in their lesson notes. They should also make it a point to let their students know these objectives, and if possible the students should be given these objectives in a written form. He also noted that the teacher should refer to the objectives in the course of teaching. It seems to be in line with Duchastel and Merril (1973) who opined that objectives would certainly make no difference if the student pays no attention to them in the learning situation. Presenting students therefore with behavioral objectives of a lesson topic at the beginning of the instruction can alert their sensitivity to the learning situation. Referring students to these objectives at every stage of information presentation can serve as an evaluating role for teachers teaching as well as students learning, thus, helping to promote learning and positive attitude.

As one may deduce, objective- based and small group work are most popular modes of teaching. For thousands of years, teachers have known that it is possible to transfer factual knowledge and conceptual understanding through the process of objective- based with small group. Unfortunately although it has the potential to greatly facilitate the learning process; it also has the capacity to turn a child off to learning if done incorrectly (Braldi, 1998). This study was to find out if behavioral objective- based instruction with small group work will affect students' achievement in mathematics.

3. Research Design And Methodology

The study adopted pre-test post-test Experimental design with matched experimental and control in which 8 form three students were sampled in three strata of pure Boys' schools, pure Girls' schools and Co- Educational schools in Mumias sub-county. Two pure boys' schools were purposively sampled while three girls' and co-educational were randomly and disproportionately sampled.

There were 4 groups E1, E2, E3 and C groups randomly selected; E1 used Behavioral Objective-Based (BOB) instructional strategy, E2 used Peer Instruction enriched with Concept Tests (PICT), E3 used both BOB and PICT strategies (BO-PICT), while C used the traditional method (TI).

Table 3. 1: Distribution of students in Experimental and Control groups

3.1 Students' Motivation Questionnaire (SMQ)

This instrument was used to assess the students' motivation and interest towards the mathematics course. It was constructed based on Malone (1981) motivation theories and Keller's ARCS (attention, relevance and satisfactory) motivation theory (Keller and Suzuki, 1988) as outlined in the following matrix.

Table 3.2: The Motivational variables (after Malone1981 and Keller and Suzuki, 1988

The SMQ testing instrument contained items on favorable and unfavorable statements on the subject's motivation towards BOB, PICT, BO-PICT mediated lessons and teacher mediated lessons (conventional) on the mathematics course (see Appendix 5). Pre-test data on the subjects' motivation towards the treatments were collected from all the randomly selected subjects in groups (C, E1 E2 and E3). Also post test data was gathered from all the subjects at the end of the experiment. The data gathered from both pretest and posttest were scored and analyzed. Analysis involved means, standard deviation, frequencies, t- test and ANOVA statistical techniques. The results of the analysis are interpreted and discussed in chapter four and five.

Descriptive and inferential statistics were used to analyze.

Table 3.3: Test statistics to address each objective

4. Findings, Presentation Interpretation And Discussion

The students' attitude questionnaire (SAQ) which had 20 items was used as a measure. The ranks (Likert type scores) were converted into ratio type scores basing on the fact that higher scores on the Likert scale means a positive attitude. Arithmetic mean and standard deviation of pre- test scores on SAQ were calculated for both Experimental and Control groups. The results were as shown in Table 4.1.

Table 4.1: Arithmetic mean and standard deviation of pre- test scores on SAQ

Table 4.2 reveals that the pre- test means scores of the Control group was 34.6 while those of the Experimental groups (E1, E2 and E3) were 33.9, 34.1 and 35.3 respectively. This suggests that the attitude scores seem identical. To show whether there was a significant difference between the pre-test mean scores of the groups, an ANOVA was calculated and results shown in Table 4.2

Table 4.2: An ANOVA of pre-test scores on SAQ

Significance at 0.05 levels, critical value 1.864< 3.84

It is evident from table 4.2 that there was no significant difference between the mean scores of the four groups since the F-ratio (1.864) was less than the critical value (3.84) at an alpha level 0.05. This is an indication that the groups in question are comparable and had similar entry behavior before commencement of lessons on Compound Proportion and Rates of Work. It is however necessary that a t-test be performed to determine if indeed the mean scores are similar. As such an independent samples t- test of the pre- test results on SAQ was calculated at 0.05 level of significance and results were as shown in Table 4.9.

Table 4.3 : An independent sample t- test of SAQ pre- test results

Results in table 4.3 indicate that all the calculated t-values on SAQ showing extent of difference between scores of subjects in experimental groups and control group are less than the t-critical value at 0.05 alpha level. The calculated t-value of C and E1 (t, 1,161) =0.579, C and E2 (t1, 163) =0.385, C and E3 (t 1,164) = 0.530, E1 and E2 (t I, 161) =1.59, E1 and E3 (t 1,162) =1.09 as well as E2 and E3 (t 1,164) =0.882 are all less than 1.658 indicating non statistical difference between pairs of groups. In fact, a further analysis of the difference using Scheffe post hoc analysis procedure yielded the trend C= E1=E2=E3 at $p<0.05$.This implies that there was no significant difference between the attitude pre-test mean scores of students in the Experimental and Control groups. Hence the groups used in the present study were homogenous and suitable for the study.

However, after the implementation of use of BOB, PICT and BO-PICT strategies, it can be argued that the mathematics course benefitted students in all the groups whereby the scores of the students on the SAQ improved remarkably. Arithmetic mean and standard deviation of post- test scores on SAQ were calculated for both Experimental and Control groups and the results were as shown in Table 4.4 and Figure 4.2

Table 4.4: Comparison of mean scores, standard deviation and mean gain on SAQ

Figure 4.1; comparison of SAQ pre-test and posttest means

Table 4.4 and figure 4.2, show that the posttest mean for C, E1, E2 and E3 are 43.6, 62.4, 64.5 and 72.9 respectively. It is evident that the mean scores for experimental groups were higher than that for control group. The mean gain for experimental groups E1, E2 and E3 were 28.5, 30.4 and 37.6 respectively while that of the control group was 9.0. This shows that the E1, E2 and E3 had positive effect on students' attitude towards mathematics.

Individual item analysis was done by the researcher on SAQ. It had 10 positive statements and 10 negative statements. Positive statements are aspects of attitude that supports the instructional strategy in question, for example "the lesson was interesting," while negative statements do not support the instructional strategy, for example "the lesson was boring". As such, the Control group C had 820 positive responses and 820 negative responses, Experimental group E1 had 800 positive responses and 800 negative responses, Experimental group E2 had 820 positive responses and 820 negative responses and Experimental group E3 had 830 positive responses and 830 negative responses. A close scrutiny highlights how students responded on the SAQ positive statements of the post- test as in Table 4.5.

Table 4.5: Frequency on SAQ positive

RESPONSE	GROUP							
	C		E1		E2		E3	
	N	%	N	%	N	%	N	%
Agree	89	10.9	497	62.1	578	70.5	625	75.3
Disagree	674	82.2	294	36.8	230	28.0	196	23.6
Undecided	57	6.9	9	1.1	12	1.5	9	1.1
Total responses	**820**	**100**	**800**	**100**	**820**	**100**	**830**	**100**

Examining results from table 4.5, it can be seen that in the control group, out of 820 positive responses, 89 (10.9%) were in agreement, 674 (82.2%) disagreed while 57 (6.9%) were undecided. In the experimental group E1, out of 800 positive responses, 497 (62.1%) were in agreement with the positive statements, 294 (36.8%) disagreed while 9 were undecided. In the experimental group E2, out of 820 positive responses, 578 (70.5%) were in agreement with the positive statements, 230 (28%) disagreed while 12 (1.5) were undecided. In the experimental group E3, out of 830 positive responses, 625 (75.3%) were in agreement with the positive statements, 196 (23.6%) disagreed while 9 (1.1%) were undecided.

The results in the table indicate that the students in the experimental groups affirmed with the positive statements than those ones in the control group. It can be noted that students who used both behavioral objective-based and peer instruction enriched with concept tests (BO-PICT) had better attitudes towards mathematics since 75.3% of the positive statements were in affirmation. Those ones who used peer instruction enriched with concept tests alone had better attitudes than those ones who used behavioral objectives. The results also indicate that most of the students in the control group had a negative attitude towards mathematics since 82.2% disagreed with the positive statements. This may be attributed to lack of use of BOB, PICT and BO-PICT. Therefore there is some indication that BOB, PICT and BO-PICT were effective in promoting the students' factual, conceptual and procedural understanding of the mathematical concepts in Compound Proportion and Rates of Work. Negative statements were also analyzed and results recorded in Table 4.6.

Table 4.6: Frequency on SAQ negative statements

Inferring from table 4.6, it can be noted that in the control group, out of 820 negative responses, 448 (54.6%) were in agreement, 361(44%) disagreed while 11 (1.4%) were undecided. In the experimental group E1, out of 800 negative responses, 240 (30%) were in agreement with the negative statements, 541 (67.6%) disagreed while 19 (2.4%) were undecided. In the experimental group E2, out of 820 negative responses, 229 (27.9%) were in agreement with the negative statements, 563 (68.7%) disagreed while 28 (3.4%) were undecided. In the experimental group E3, out of 830 negative responses, 174 (20.9%) were in agreement with the negative statements, 643 (77. 5%) disagreed while 13 (1.6%) were undecided.

Moreover, the results in table 4.7 infer that, more students from the control group agreed with the negative responses. This implies that students in the control group had poor attitudes towards mathematics. Comparatively most students in the Experimental groups were not in agreement with the negative statements, implying that their attitudes towards mathematics were positive.

To show whether there was a significant difference between the SAQ mean scores of the groups (E1, E2, E3 and C), an ANOVA was calculated and results shown in Table 4.7

Table 4.7: An ANOVA of post-test scores on SAQ

Results in table 4.13 suggests that there was a difference between the mean scores of the control group and the experimental groups since the F-ratio (44.32) was greater than the critical value (3.84) at an alpha level 0.05. However, it was important to determine the direction of the difference and therefore an independent samples t- test of the post- test results on SAQ was calculated at 0.05 level of significance and results were as shown in Table 4.8.

Table 4.8: an independent sample t- test of SAQ post- test results

Results in table 4.8 reveal that the t-value for E1 and E2 (t1, 161=0.94) are not statistically different; but the t-values of groups E1 and C (t 1,161= 9.18), E2 and C (t 1,163=10.66), E3 and C (t 1,164=15.42), E1 and E3 (t 1,162=4.81) as well asE2 and E3 (t 1,164=4.00) indicate statistical differences in the post test mean scores in favor of the treatment groups. The Scheffe post hoc analysis procedure was further carried out on the results in order to find out where the significant difference lies. The results supported the ones for the t-test and yielded the trend BO-PICT (E3)>PICT (E2) BOB (E1) > TI (C) for SAQ measure.

From the results it is established that the experimental groups were superior to that of the control group, however a further scrutiny of the results show that the treatment of the Experimental groups did not have the same effects on the students, BO-PICT was superior to BOB and BO-PICT.

In view of the foregoing, therefore the hypothesis which states that there is no significant difference between attitude scores of students taught compound proportion and rates of work using BOB, PICT and BO-PICT and their counter parts in the control group is rejected at $\alpha=0.05$. This means that there was a difference in the attitude development based on the instructional practice adopted for instruction.

In support of these findings are earlier discussions by Mager (1962) who popularized the use of behavioral objectives in his class on preparing instructional objectives. According to him if a learner is provided with a copy of behavioral objectives the teacher does less work. Knowledge of behavioral objectives can be useful in indicating to the learner what is actually required of them instead of wondering over the learning materials and as a result relevant learning achievement and attitude are promoted. This is also in line with Melton (1978) who supported the use of behavioral objective by pointing out that behavioral objectives clearly indicate to students what is required of them and as a result relevant learning is enhanced.

Small-group learning is clearly successful in a great variety of forms and settings and holds considerable promise for improving students' attitude towards secondary school mathematics. As recommended by Westberg and Jason (1996), "Innovations and successes in education need to spread with the speed and efficiency of new research results" (pp. 5-6). Effective action will require bridges among policymakers at national, state, institutional, and departmental levels and between practitioners and scholars across the disciplines. Through cooperation among representatives of these diverse groups, progress can be made toward promoting broader implementation of small-group learning

5. Summary, Conclusions and Recommendations

5.1 Summary of Major Findings

The results obtained in this study show that there was no significant difference between Experimental groups and the Control group in the SAQ pre- test examination.

Although group E3 that used BO- PICT developed better attitudes than the other two Experimental groups in terms of mean scores, there was no statistically significant difference between group E1who used BOB and group E2 who used PICT. They had statistically similar results.

5.2 Conclusion

The knowledge of behavioral objectives and peer instruction may have help the students to perceive learning as relevant and meaningful thus, fostering a positive attitude in them towards mathematics.

Students have a limit to which they can grasp, perceive, conceptualize and apply, it is imperative that the learning of mathematics concepts be presented in such a way that multi-practices instructional strategies can be used. This is because when BOB and PICT were used together as BO-PICT, there was positive attitude development.

Interaction during the learning process enhances learning of mathematical concepts even if such concepts are perceived to be difficult or abstract. Hence the groups that used interactive methods yielded better performance in mathematics.

Mathematics is not difficult if effective interactive methods like BOB, PICT and BO-PICT are used in learning.

5.3 Recommendations

Whenever the matter at hand requires positive students' attitude development towards the subject embrace the use of BOB, PICT and BO- PICT. Teachers should understand and appreciate that the teaching of mathematics would greatly be enhanced in the event that they use various instructional strategies like BOB, PICT and BO-PICT. There should be in-service training for teachers to enable them learn more so that they are able to use more instructional practices in their lesson delivery to motivate the students and ensure better performance in their studies.

The Government need to motivate their teachers to encourage them put in their best to ensure that all students receive proper learning of mathematics through various instructional practices like BOB, PICT and BO-PICT. Recruit more qualified teachers to be able to cope with the increasing population of secondary school students. Seminars and workshops on

BO-PICT instructional strategy for teachers so that they can adopt it for effective classroom instruction and students' motivation.

There is need to understand more about how BOB, PICT and BO-PICT can influence attitude development and acquisition of better motivation. Further research include the following: Research of the same kind with a large sample is in the same area of Study (Mumias Sub County) and Kakamega County; a large sample in some other instructional practices in mathematics and other sciences in a different area of study; same kind with a large sample is recommended in a different area of study. Research can be done on the effect of effect of instructional strategies in achievement and motivation in mathematics and other areas of study and the overall performance.

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Appendix : Tables And Figures

Table 3.1: Distribution of students in Experimental and Control groups

Group	No of schools	No of students
E1	2	80
E2	2	82
E3	2	83
C	2	82
TOTAL	8	327

Table 3.2: The Motivational variables (after Malone1981 and Keller and Suzuki, 1988

MALONE	**KELLER**	**DESCRIPTION**
Fantasy	Attention	The extent to which the subjects felt encouraged and applied the information he/ she learned in the course
Challenge	Confidence	The extent to which the subjects finds the information satisfactory, that is not too easy or difficult or unclear to learn the course successfully
Curiosity	Satisfactory	The extent to which the subjects find the lesson attractive, surprising and challenging, that's he/she considers it to be fun
Control	Relevance	The extent to which the subjects find the information useful to the future

Table 3.3: Test statistics to address each objective

Research objective	Independent variable	Dependent variable	Test statistics
1	1.BOB 2.PICT 3.BO-PICT	Attitude of students towards learning of mathematics.	Frequencies, mean scores and percentages. ANOVA t-test

Table 4.1: Arithmetic mean and standard deviation of pre- test scores on SAQ

GROUP	C		E1		E2		E3	
SCALE	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	34.6	8.00	33.9	7.4	34.1	8.56	35.30	8.92

Table 4.2: An ANOVA of pre-test scores on SAQ

SOURCE	D.F	S.S	M.S	F-RATIO	Critical value
BETWEEN GROUPS	4-1=3	5353.2	1784.4	1.864	3.84
WITHIN GROUPS	327-4=323	309206.652	957.30		
TOTAL	326	310991.05	2741.7		

Significance at 0.05 levels, critical value 1.864< 3.84

Table 4.3 : An independent sample t- test of SAQ pre- test results

Instructional approach	N	Mean	SD	DF	Cal t	Cri t	Remark
E1	80	33.9	7.404	161	0.579	1.658	No sig difference
C	82	34.6	7.9995				
E2	82	34.1	8.554	163	0.385	1.658	No sig difference
C	82	34.6	7.9995				
E3	83	35.3	8.92	164	0.530	1.658	No sig difference
C	82	34.6	7.9995				
E1	80	33.9	7.404	161	1.59	1.658	No sig difference
E2	82	34.1	8.554				
E1	80	33.9	7.404	162	1.09	1.658	No sig difference
E3	83	35.3	8.92				
E2	82	34.1	8.554	164	0.882	1.658	No sig difference
E3	83	35.3	8.92				

Table 4.5: Frequency on SAQ positive

RESPONSE	**GROUP**							
	C		**E1**		**E2**		**E3**	
	N	%	N	%	N	%	N	%
Agree	89	10.9	497	62.1	578	70.5	625	75.3
Disagree	674	82.2	294	36.8	230	28.0	196	23.6
Undecided	57	6.9	9	1.1	12	1.5	9	1.1
Total responses	**820**	**100**	**800**	**100**	**820**	**100**	**830**	**100**

Table 4.7: An ANOVA of post-test scores on SAQ

SOURCE	D.F	S.S	M.S	F-RATIO	SIG
BETWEEN GROUPS	4-1=3	203,216.01	67738.67	44.32	3.84
WITHIN GROUPS	327-4=323	493673.2	1528.4		
TOTAL	326				

Significance at 0.05 level, critical value 44.32 > 3.84

Table 4.8: an independent sample t- test of SAQ post- test results

Instructional approach	N	Mean	SD	DF	Cal t	Cri t	Remark
E1	80	62.4	14.66				Sig difference
C	82	43.6	11.10	161	9.18	1.658	
E2	82	64.5	13.86				Sig difference
C	82	43.6	11.10	163	10.66	1.658	
E3	83	72.9	13.12				Sig difference
C	82	43.6	11.10	164	15.42	1.658	
E1	80	62.4	14.66				No sig difference
E2	82	64.5	13.86	161	0.94	1.658	
E1	80	62.4	14.66				Sig difference
E3	83	72.9	13.12	162	4.81	1.658	
E2	82	64.5	13.86				Sig difference
E3	83	72.9	13.12	164	4.00	1.658	