
Extent of Implementation of ASEI-PDSI Approach in Teaching Mathematics in Secondary Schools in Butere Sub-County, Kakamega County, Kenya

Christine Arego, Lydia Wamocha and Eunice Majanga
Masinde Muliro University of Science and Technology

Citation: Christine Arego, Lydia Wamocha and Eunice Majanga (2022) Extent of Implementation of ASEI-PDSI Approach in Teaching Mathematics in Secondary Schools in Butere Sub-County, Kakamega County, Kenya, *British Journal of Education*, Vol.10., Issue 6, pp. 67-78

ABSTRACT: *Activity, Student-centred, Experiment and Improvisation (ASEI) through Plan, Do, See, improve (PDSI) is used in Strengthening Mathematics and Science Education (SMASE); most commended pedagogy for Mathematics. Butere Sub County has been performing dismally in Mathematics in Kenya Certificate of Secondary Education (KCSE) examinations. This study assessed the extent to which ASEI-PDSI is used in teaching Mathematics in secondary schools in Butere Sub County. A descriptive survey design was adopted. The target population was 103 respondents. Sampling was done by stratified random sampling technique. Questionnaires and interview schedule were used to collect data. It was revealed that Mathematics teachers rarely used ASEI-PDSI approach in teaching mathematics. This was majorly blamed on lack of enough resources for the use of the approach and the approach being time consuming. It's hoped that the findings of the study will provide information to the Ministry of Education and education stakeholders concerning the implementation of ASEI-PDSI approach to improve performance of Mathematics.*

KEYWORDS: ASEI-PDSI approach, In-service Training, pedagogy, implementation

INTRODUCTION

The use of learner centred approaches has become popular in Sub- Saharan Africa and has received support from donor community (Schweisfurth, 2011). Although the approaches receive a lot of support, the implementation of the approaches has failed in most cases (Schweisfurth, 2011). A study in Namibia revealed that teachers still used lecture methods in their classrooms despite the physical science teachers making significant strides towards using the learner centred methods of teaching (Namuyenga, Ayere & Rabari, 2019). In Kenya, there has been a public outcry in mathematics every time K.C.S.E results are announced. This is despite the government's heavy investment in the Strengthening of Mathematics And Science Education (SMASE) INSET program which aims at improving the quality of teaching and learning to help upgrade the capability of young Kenyans in mathematics and science (Centre for Mathematics, Science and Technology in Africa [CEMASTEAS], 2010).

There was laxity in the use of learner-centred methods of teaching mathematics which led to poor performance (CEMASTEAS, 2010). An INSET for mathematics teachers was therefore formulated to sensitize stakeholders at the national, regional and district levels where teachers acquired better pedagogical skills that would give learners a better

opportunity of acquiring desired knowledge, attitude and skills to enable them perform better in mathematics.

The guiding principle of SMASE INSET is ASEI (Activity-based, Student-centred, Experimentation and Improvisation). This principle is implemented based on Plan, Do, See and Improve (PDSI) approach. The approach considers quality of classroom activities as critical to achieving effective teaching and learning and hence good performance in mathematics. The approach focuses on teachers to reflect on their teaching strategies and acquire skills for effective teaching and efficient learning to occur. The initiative recognizes that meaningful learning takes place in an environment in which students are actively engaged in focused and sequenced activities for acquisition of knowledge and skills (CEMASTE, 2011).

The ASEI ideology considers the quality of the classroom activities as important to achieving effective teaching and learning. The activities are hands-on (psychomotor), minds-on (reasoning), hearts-on (affective) or mouths-on (communication skills). These activities should increase the participation of the learner since they should be learner-centred (SMASSE, 2004). The study noted that the components of effective classroom communication skills include listening to understand, explaining logically, reporting and recording observed phenomena, predicting accordingly and giving reports in form of data. The ASEI-approach is anchored in five basic endeavours' to shift teaching and learning from namely: knowledge-based teaching to activity-focused teaching (talk and chalk to hands-on); teacher-centred teaching to student-centred learning; lecture method or theoretical approach to experiments or research-based approach to learning; recipe type large scale experiments to scaled-down experiments; and involving use of improvisations even with locally available materials. The approach demands for well-planned learning activities and also creativity and innovativeness (CEMASTE, 2011).

Statement of the Problem

The introduction of an in-service programme, SMASSE INSET in 1988 was to help solve the problem of mass failures in Mathematics at KCSE by changing attitude of both mathematics teachers and students; improving pedagogical content knowledge of teachers and providing teaching and learning materials (SMASSE, 2004). Since its induction in the sub-county, it is expected that the mean scores in Mathematics should be improving and become even better as teachers are equipped with ASEI-PDSI practices. This is not the case as the overall Butere sub county mean scores in Mathematics indicate low improvement in the results and this raise concerns on how the learner-centred pedagogy has influenced the grades of learners in Mathematics. There could be aspects of ASEI/PDSI approach to teaching that have not been well implemented resulting to it not being efficient. Findings by CEMASTE (2009) indicate a weak practice of ASEI/PDSI approach in the classroom, despite the MOE's heavy investment in the approach. The question is are the mathematics teachers effectively using the ASEI-PDSI approach in teaching?; do schools have the necessary teaching and learning resources for the implementation of ASEI-PDSI approach in

teaching? These questions necessitated the need for this study to find out the extent of implementation of ASEI-PDSI approach by mathematics teachers in Butere sub county, Kakamega County, Kenya.

Purpose of the study

The purpose of this study was to determine the extent of the implementation of ASEI-PDSI approach in teaching of mathematics in secondary schools in Butere sub county, Kakamega County, Kenya.

LITERATURE

Methods of teaching are a problem which faces the learning of Mathematics in secondary schools thus leading to wanting performance in examinations and tests. Teachers should have an insight and be resourceful in whatever methods they use in the classroom. Substantial research on the effectiveness of teaching methods indicates that the quality of teaching is often reflected by the achievements of learners (Adunola, 2011). In order for the method used for teaching to be effective, Adunola (2011) maintains that teachers need to be conversant with numerous teaching strategies that take recognition of the magnitude of complexity of the concepts to be covered. He indicated that in order to bring desirable changes in students, teaching methods used by educators should be best for the subject matter. ASEI/PDSI is a student-centred approach to teaching believed to have a significant impact on student's outcomes in mathematics subject.

When a teacher prepares student-centred activities and experiments (ASEI), the aim is to bring about meaningful learning where the learner is engaged with both minds on and hearts on activities. ASEI movement is believed to enable learners to develop an inquiry mind, develop the skills of making accurate observations, drawing conclusions and holding discussions to enhance learning and development of skills (SMASSE, 2002). In a study done by Mwelese and Atwoto (2014), it was found out that ASEI-PDSI had a significant effect on students' achievement. It was found that students through the ASEI-PDSI approach had a better view and attitude towards mathematics than those taught through traditional approaches (Mwelese & Atwoto, 2014).

Nevertheless, studies by Kariuki, et al (2014) titled, 'An evaluation of the effectiveness of SMASE program on performance of science and mathematics in primary schools in Kenya' shows that majority of teachers had not adopted the ASEI-PDSI approaches leading to poor results in mathematics. In addition, a similar study found out the ASEI/PDSI approach was not being practiced by most teachers in mathematics interaction and therefore the teaching approach has not improved as a result of introduction of SMASSE training. Teachers were still using the conventional ways of teaching like chalk and talk (Wafubwa, 2014).

A majority of the studies conducted on ASEI/PDSI teaching approach mainly targeted students and how the approach affected their performance in mathematics. The current study focused on mathematics teachers on how the ASEI/PDSI concepts were effective in the teaching and learning of mathematics. The study sought to find out whether the

ASEI/PDSI approach is being used by mathematics teachers during the learning of mathematics. Do teachers develop the required lesson plans needed for the implementation of the ASEI/PDSI approach?, are the learning and teaching materials available and if so, are they being utilized as expected?, do teachers put into consideration the learner differences while using the approach? These are some of the gaps that the study sought to fill.

METHODOLOGY

Research Design

For the purpose of this study, a descriptive survey design was selected because of its high degree of representativeness and the ease in which a researcher could obtain participants opinion. In this study, the researcher intended to obtain the opinions of the respondents with regard to the methods of teaching used in Mathematics, how often the teachers of mathematics prepared the ASEI lesson plan, the attitude of teachers towards implementation of ASEI/PDSI approach in teaching Mathematics, and availability of the teaching and learning resources to enhance the use of ASI-PDSI approach. Orodho (2012) says that a survey design is intended to collect data by interviewing or administering a questionnaire to a sample of individuals.

Target Population

The target population is the total group of individuals from which the sample might be drawn. The study was carried out in public secondary schools in Butere Sub County. Public secondary schools in Butere Sub County were of interest to the researcher because of their continued dismal performance in mathematics at form four levels as from the background information. The units of analysis for this study are Mathematics teachers, school principals and QASO Sub County. The target population comprised of 31 principals, 70 mathematics teachers and 1 QASO in the sub-county yielding a total population of 102 (Butere Education office). Principals and mathematics teachers were targeted because the researcher sought to investigate teacher characteristics influencing performance in Mathematics.

Sampling Size and Sampling Techniques

A sample is the group of people who take part in the investigation. Stratified sampling was used. The sample was determined from secondary schools in Butere sub-county after categorizing the schools into three strata made up of high performing, middle performing and low performing schools. The KNEC mathematics mean scores of schools in Butere was obtained from the sub-county examinations office and was used to determine school performance levels. An average of each school's KCSE mean score in three recent consecutive years in the sub-county was used to categorize them as low, middle and high performing schools. Mugenda and Mugenda (2003) postulates that a sample size of 10-50% is enough for a descriptive research. The 16 schools that were selected comprised 50 percent of the target population of 30 public schools in Butere sub-county. The principals of the 15 schools were selected. The researcher also sampled 50 percent of the population of mathematics teachers. The sample size is shown in Table 1.

Table 1. Sample Size

Category	Population size (N)	Sample size (n)	Percentage
Principals	30	15	50
Mathematics teachers	70	35	50
QASO	1	1	100
Total	101	51	200

Source: Education Office Butere Sub County (2021)

Research Instruments

The instruments that were used for data collection included questionnaires and an interview schedule. The questionnaires were used since they enabled the researcher to reach a large sample within a short time. The questionnaires are also easier to complete and the researcher was able to easily detect a trend just by glancing at the responses (Orodho, 2012). The researcher administered the questionnaires to principals and mathematics teachers in their respective schools. Performance of the target teachers was measured by the mean scores attained in Mathematics. This data was collected from the KSCE mean scores in mathematics for all the schools' sub-county.

Validity of the Instruments

Validity of the instruments refers to the degree to which a test measures what it is supposed to measure. A research instrument is valid if its content is relevant and appropriate to research objectives. To establish the validity, the instruments prepared by the researcher were given to two supervisors to evaluate the relevance of each item in the instrument to the objectives. Suggestions from the supervisors and the pilot results were incorporated in revising the items for the final study.

Reliability of the Instruments

Reliability as a measure of degree to which a research instrument yields consistent results after repeated trials. It demonstrates the extent to which the operations in a study such as data collection can be repeated and similar results are obtained and the attributes being measured is believed not to have changed in the interval between measurements even if the test is administered by different people using same or alternative forms of the test. A measure is deemed reliable if an individual's score on the test is the same when given more than once in similar test and under similar circumstances. A reliable instrument or test must meet two conditions; it must measure a single dimension and it must have a small random error.

In this study Cronbach's alpha coefficient which is the most common measure of scale of reliability was used to measure reliability of the questionnaire. This test was selected over the other tests on the strength that it has been applied to similar studies, Venkatesh et al, 2003. The generally agreed lower limit for Cronbach's alpha is 0.7, Davis 1989. If the value obtained in any test is below 0.7 the test is normally considered not to be reliable. The method of internal consistency for establishing reliability is mainly on finding out how the respondents responded on all items or a group of items on the questionnaire. The reliability estimates generated by this method is known as coefficient of internal consistency.

Piloting

To ascertain the reliability of questionnaires and interview schedule, the researcher conducted a pilot study in two public secondary schools in the sub county. The questionnaires were administered to the principals and Mathematics teachers of the selected secondary schools. The purpose of piloting was to find out whether the items of the instruments were precise and comprehensive enough to provide the anticipated data and to determine whether the research hypothesis can be tested and after which appropriate changes were made on the instruments. The respondents used in the pilot study were excluded from the main study. The alpha scores are shown in Table 2. The scores were obtained when all the items in the questionnaire were subjected to Cronbach's alpha test in order to check on the internal consistency based on inter-item correlation. The questionnaire items obtained the recommended alpha score of above 0.7. The reliability analysis results in Table 2 show that alpha coefficient of 0.770, is considered to be a very good score. Based on these results, it evident that the questionnaire was a reliable measuring instrument for data.

Table 2. Reliability Test of Pilot Test Items in Questionnaire

Instrument	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of items
Teacher's questionnaire	0.727	0.712	35
Principal's questionnaire	0.748	0.735	16

Data Collection Procedure

The researcher visited the sampled schools and distributed questionnaires to principals and mathematics teachers. The researcher also conducted an interview with QASO Sub County. The researcher used school mean scores from the sampled schools as data for the dependent variable. The procedure for data collection involved obtaining a letter from the Directorate of Postgraduate Studies (DPS) Masinde Muliro University to carry out the study. This was followed by getting a research permit from the National Council for Science and Technology (NACOST). It also involved getting permission from the County Director of Education and the schools management and finally getting permission from the County Commissioner before distributing questionnaires.

Data Analysis

The objectives of the study yielded quantitative data. Quantitative data using the questionnaire was analyzed by the use of descriptive statistics using the Statistical Package for Social Sciences (SPSS) and presented through percentages, means, standard deviations and frequencies. The information was displayed by use of bar charts, tables and pie-charts. This was done by tallying up response, computing percentages of variations in responses as well as describing and interpreting the data in line with the objectives and assumptions through use of SPSS. The data that was collected using interview guidelines which is qualitative in nature was analyzed using conceptual content analysis which is the best suited method of analysis. Conceptual content analysis as defined by Creswell (2003) is a technique for making inferences by systematically and objectively identifying specific characteristics of messages and

using the same approach to relate trends. The study used the Regression analysis to analyze the relationship between the dependent and independent variables. A regression analysis can be used to assess how well an independent variable can predict a dependent variable. The Regression scatter plot was used to test H01, H02, H03 and H04.

RESULTS

ASEI/PDSI Approach in Teaching

The objective of the study was to find out the relationship between implementation of ASEI/PDSI approach in teaching mathematics and students' performance in the subject. The researcher sought to find out the extent to which mathematics teachers use ASEI/PDSI approach. The respondents were asked to state the method that is commonly used during a mathematics lessons. The information was represented in Figure 1.

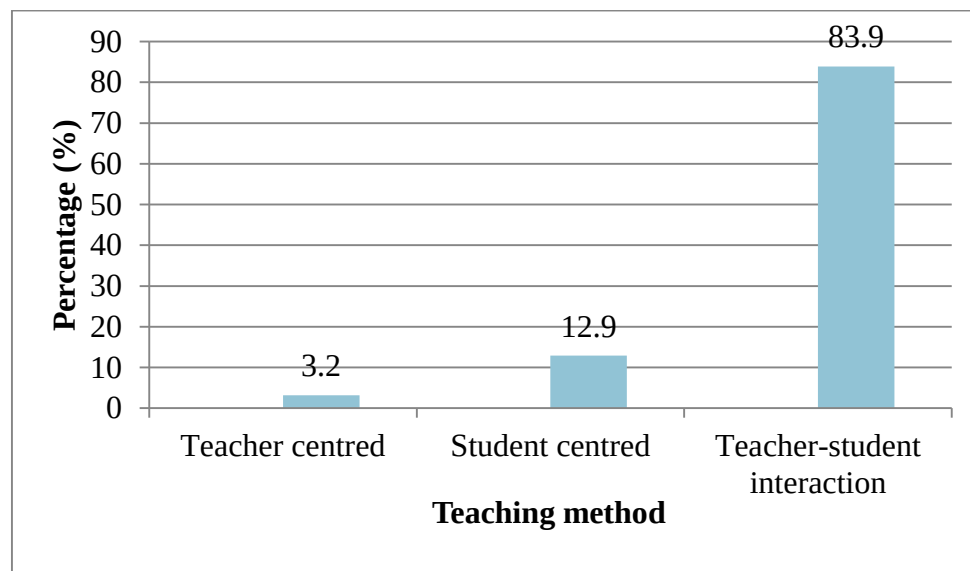


Figure 1. Teaching Methods used in Mathematics

From the results in Figure 1, it is evident that the teacher-student interaction method was the most commonly used method of instruction in mathematics lessons as reported by 26 (83.9%) of the teacher respondents. Another 4 (12.9%) of the teacher respondents reported that mathematics was taught using student-centred method(13%) while one (3%) respondent was using the teacher-centred method. In addition, the teacher respondents were to indicate their level of agreement or disagreement with the given statements and the findings were as indicated in Table 3.

Key; SA: Strongly Disagree A: Agree D: Disagree SD: Strongly Disagree.

Table 3. Implementation of ASEI/PDSI Approach in Mathematics Lessons

Statements	Percentages (%)				
	SA	A	U	D	SD
Students learn best by finding solutions to problems on their own	32	55	7	0	6
Students are able to give their perceptions and prior experiences about concepts	7	71	16	6	0
In all the lessons, there is use of improvised materials effectively	7	29	55	7	2
All my lessons are activity-based as practical work is given	0	65	29	6	0

Findings in Table 3 show that majority of the teachers (87%) were in agreement that students learn best by finding solutions to problems on their own while another 78% indicated that their students were able to give their perceptions and prior experiences about concepts. However, it is important to note that 36% of the teacher respondents indicated that there was effective use of improvised materials in the teaching of mathematics. Nevertheless, 65% of the teachers reported that their mathematics lessons they taught were activity based as practical work was given. The researcher sought to find out how often the administrators of the schools observe mathematics lessons to ensure implementation of ASEI/PDSI approach in teaching and the findings were as shown in Table 4.

Table 4. Frequency of Observing Mathematics Lessons by Principals

Option	Frequency (F)	Percentage (%)
Sometimes	8	53.3
Often	4	26.7
Rarely	2	13.3
Always	1	6.7
Total	15	100

Results in Table 4. indicate that most of the principals constituting 53.3% sometimes observed mathematics lessons while only 6.7% of them always monitoring the mathematics lessons. This could be because of the tight schedule the principals who have multiple roles in the school and some who are teachers of other subjects may lack interest in the mathematics lessons. However, it is still the responsibility of principals to monitor all lessons irrespective of their teaching subjects. When the teaching and learning process is not monitored, laxity sets in and quality may not be assured. These findings corroborate with those gathered during the interview with the Butere Sub County QASO who was asked how frequent he monitors the implementation of the ASEI/PDSI approach in class during mathematics lessons. The Sub County QASO indicated,

“You know I have a lot of work. I am alone as the Sub County QASO. There are many things I handle. But I always try and monitor the implementation of ASEI/PDSI at least once a year. I visit each school and physically monitor the mathematics lessons. But doing it once a year cannot be effective. Remember, the actual monitoring is done by the principals, may be you will get time to ask them how they do it.”

The researcher sought to find out whether the schools had the necessary teaching and learning resources to ensure use of ASEI/PDSI pedagogy and the findings were summarized as in Table 5.

Table 5: Availability of Necessary Resources in Schools for ASEI/PDSI Pedagogy

Option	Frequency (F)	Percentage (%)
Resources are not available	17	54.8
Resources are available	8	25.8
Not Sure	6	19.4
Total	31	100

Findings in Table 5 show that slightly more than half of the teacher respondents (54.8%) confirmed that their schools did not have enough teaching and learning resources to implement the ASEI/PDSI approach with only 25.8% of them indicating that they had adequate resources. However, it is worth noting the 19.4% of the teachers who reported that they were not sure whether the resources were adequate.

DISCUSSION

From the results in Figure 1, it is clear that majority of the teachers adopted the teacher-student interaction method. This means that in the absence of the teacher, no learning of mathematics takes place. It is worth noting that the most praised method of instruction (student centred), which is adopted by ASEI/PDSI was used by only 12.9% of the teachers. This is an indication that the SMASE advocated method of teaching is not adopted by a huge majority of the teachers. This may also imply that most teachers attend SMASE training for the sake of it and are not ready to adopt the methodology that SMASE advocates.

Findings in Table 3 indicate that majority of the teachers indicated that students learn best by finding solutions to problems on their own and that their students were able to give their perceptions and prior experiences about concepts. At the same time, there teachers effectively used improvised materials in the teaching of Mathematics and that the Mathematics lessons the taught were activity based; as more practical work was given.

From the results in Table 4, most of the principals observed Mathematics lessons sometimes, with only a few of them who always monitoring the Mathematics lessons. This could be because of the tight schedule the principals who have multiple roles in the school and some who are teachers of other subjects may lack interest in the

mathematics lessons. However, it is still the responsibility of principals to monitor all lessons irrespective of their teaching subjects. When the teaching and learning process is not monitored, laxity sets in and quality may not be assured.

These findings corroborate with those gathered during the interview with the Butere Sub County QASO who was asked how frequent he monitors the implementation of the ASEI/PDSI approach in class during mathematics lessons. The Sub County QASO indicated,

“You know I have a lot of work. I am alone as the Sub County QASO. There are many things I handle. But I always try and monitor the implementation of ASEI/PDSI at least once a year. I visit each school and physically monitor the mathematics lessons. But doing it once a year cannot be effective. Remember, the actual monitoring is done by the principals, may be you will get time to ask them how they do it.”

If the teachers are not sure whether the resources are adequate as indicated in Table 5, who else should know? This clearly implies that such teachers have no interest in the ASEI/PDSI approach in the teaching of mathematics. The ASEI/PDSI approach demands for the use of locally improvised materials and lack of these materials could hinder its application in mathematics lessons. It is the teachers who are expected to improvise the teaching and learning resources.

The findings indicate that student – teacher interaction is the most common method of teaching mathematics in secondary schools of Butere Sub county. Most teachers had not adopted the ASEI/PDSI approach in the teaching of mathematics in their schools because of the limited resources to implement the approach with principals not prioritizing the monitoring of mathematics lessons being taught. Nevertheless, both principals and teachers appreciate that ASEI/PDSI is the best approach since it helps students find solutions their own problems in mathematics. Teachers appreciate the fact that ASEI/PDSI approach is enhances the mathematical skills among the students. However, due to the demanding nature of the activities involved, pressure to cover the syllabus and lack of adequate resources in the schools to implement ASEI/PDSI, most teachers feel it is not practical to implement the approach and consequently do not implement the approach in the mathematics lessons.

These findings concur with (SMASSE, 2002) that indicated that ASEI enables learners to develop an inquiry mind, develop the skills of making accurate observations, drawing conclusions and holding discussions to enhance learning and development of skills. At the same time, the findings are in agreement with Wafubwa (2014) who established that the ASEI/PDSI approach was not being practiced by most teachers in mathematics interaction and therefore the teaching approach has not improved as a result of introduction of SMASSE training. Similarly, the findings were in agreement with Kariuki et al. (2014) who revealed that a majority of teachers had not adopted the ASEI-PDSI approaches leading to poor results in mathematics while contradicting Mwelese et al. (2014) who established that students through the ASEI-PDSI approach had a better view and attitude towards mathematics than those who were taught through traditional approaches.

Implication to Research and Practice

The findings may assist in the review of strengths and weaknesses of all existing policies on teacher training programs in Mathematics, workshops and seminars in Mathematics. It would assist the schools' administration and in policy making where vital decisions of acquiring and distributing of relevant education resources is got. The ideas could be used by the school organization to train and hire quality teachers who can improve the education standards of students. In addition, the findings will help teachers evaluate their teaching methods in the classroom and help them incorporate improvised teaching and learning resources so that learners can develop a positive attitude. At the same time, school administrators may facilitate frequent mathematics workshops to enhance teachers' confidence and capabilities for effective implementation of the ASEI-PDSI approach when teaching mathematics. Furthermore, CEMASTEIA may use the study findings to sensitize principals of schools on their role in implementation of the aspects of ASEI/PDSI approach; administrators should participate fully in the training activities to serve as role models to the mathematics teachers. At the same time, the Ministry of education should avail resources for the implementation of ASEI/PDSI approach in all schools. The findings will enrich teaching approaches, identify and give a probable and workable solution to some of the problems facing teachers in teaching Mathematics. Furthermore, the study findings are of benefit as they open more research gaps for future research in the field of education, particularly in dealing with teacher factors influencing students' performance in Mathematics in the K.C.S.E examination Butere sub county, Kenya. The findings will form baseline information to be used by researchers to conduct further research.

CONCLUSIONS

The study established that though principals had a positive perception of their supervision of ASEI/PDSI approach, teachers still faced challenges in the implementation of the approach. The challenges included; limited resources in the schools, too many topics in the mathematics syllabus and negative attitude from the students. The poor performance of learners in mathematics was as a result of inadequate implementation of the ASEI-PDSI approach. Not all the aspects of the approach were being implemented by mathematics teachers in secondary schools.

Future Research

Based on the findings of this study, there is need to conduct research on:

- i. The Funding of the SMASE INSET programme and motivation of the mathematics teachers; and
- ii. Similar studies could be done in the three sciences in secondary schools to establish the relationship between ASEI/PDSI approach and the performance of learners in the subjects.

REFERENCES

Adunola, O. (2011) *The Impact of Teachers Teaching Methods on the Academic Performance of Primary School Pupils in Ijebu-Odu Local Cut Area of Ogun State*, Ego Booster Books, Ogun State, Nigeria.

- CEMASTE. (2009) Report on monitoring and evaluation of regional INSET. Unpublished. Nairobi.
- CEMASTE. (2010) *Effective Implementation of SMASE primary Activities; SMASE primary project*, CEMASTE, Nairobi, Kenya.
- CEMASTE, (2011). *Effective implementation of SMASE primary activities*, CEMASTE, Kenya.
- Kariuki, J.K., Kiprop, L.W. and Thinguri, R. (2014) *An Evaluation of the Effectiveness of SMASSE program in Performance of Science and Mathematics in Primary Schools in Kenya*. International Journal of Education & Research. Vol.2 No.6. Retrieved www.ijern.com.
- Mwelese, J.K. and Atwoto, J.O. (2014) *The Influence of the ASEI-PDSI approach on Students' views and attitudes towards mathematics instruction*. Journal of Education and Practice, 5(24), 146-152. Retrieved from www.iiste.org.
- Namuyenga, W.S., Ayere, M. and Rabari, J. (2019) *Extent of Use of ASEI-PDSI Approach in Teaching of Science in primary schools in Emuhaya Sub county, Vihiga County, Kenya*. European Journal of Education Studies. 322-343.
- Orodho, A.J. (2012). *Techniques of Writing Research Proposals and Reports of Education and Social Sciences*. Masiola Publishers, Nairobi.
- Schweisfurth, M. (2011) *Learner-Centred Education in Developing Country Context; from solution to problem?* International Journal of Education Development, 31(5), 425-432).
- SMASSE. (2002) *Report on the 4th workshop on effective operations and management of SMASSE project*. Nairobi: SMASSE project.
- SMASSE INSET (2004) *Materials on Facilitation*, Kikuyu, Thogoto TTC.
- Wafubwa, K.N. (2014) *The influence of Strengthening of Mathematics and Science in Secondary Education (SMASSE) project in the instruction of mathematics in secondary schools of Rangwe Division, Homabay county, Kenya*. Med Thesis, Kisii University.