European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available online at: www.oapub.org/edu

DOI: 10.46827/ejes.v10i9.4966 Volume 10 | Issue 9 | 2023

IMPACT OF SMASSE INSET ON STUDENTS' ATTITUDE AND PERFORMANCE IN MATHEMATICS IN SECONDARY SCHOOLS IN BOMET COUNTY, KENYA

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Abstract:
Performance in mathematics has been steadily deteriorating over the last few years. This prompted the researcher to investigate the impact of SMASSE INSET on students' attitudes and performance in mathematics. The objectives of the study were to investigate whether SMASSE INSET has changed the students' attitudes, improved the performance and the teaching approaches and methodology in mathematics. This study was based on the theory of Reasoned action and the theory of Planned behaviour as proposed by Ajzen and Fishbein (1975 and 1980). This was a field study that was conducted in Bomet district. A descriptive survey design was adopted for the study. The respondents of the study were selected from the Form four students of the year 2008. A sample of 371 students, 20 mathematics Heads of Department and 20 Mathematics teachers were selected using both stratified and simple random sampling. Data was collected through the use of students' questionnaires, HOD Mathematics Questionnaire and Teacher's Questionnaire. Analysis of data was done using both descriptive and inferential statistics. For descriptive statistics, frequency tables, means and standard deviations were used. Analysis of variance (ANOVA) was employed for the inferential statistics. The study established that the students' attitudes towards mathematics have greatly improved as a result of SMASSE INSET. The study also found out that teacher's teaching approaches and methodology have greatly improved as a result of SMASSE INSET. However, the attitude and teaching approaches could not translate to good performance. In order to make SMASSE INSET more effective in schools and in the teaching of mathematics, it could be included in the programmes of Teacher Education at the level of teacher preparation.

Keywords: SMASSE INSET, performance, mathematics

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1. Introduction

A baseline survey carried out by SMASSE personnel in 1998 isolated the following problems in the teaching and learning of mathematics and science at the secondary level that contributed to poor performance:

1) Attitudinal factors,
2) Poor teaching methodology,
3) Lack of content mastery,
4) Lack of a professional forum for teachers to share their experiences,
5) Inadequate development of appropriate teaching/ learning materials,
6) Administrative factors,
7) Gender disparity.

SMASSE project was therefore formulated as an intervention measure to address the problem. The overall goal of the SMASSE project is to "*upgrade the capability of young Kenyans in mathematics and science*".

In order to realize this goal, the project was designed with the following project purpose, that is to "*strengthen mathematics and science education at secondary school level through the INSET of serving teachers in Kenya*".

SMASSE came into being when the consistently poor performance in mathematics and Science (Biology, Chemistry and Physics) became a matter of serious concern. Broad curricula, lack of facilities and inadequate staffing were always cited as the major causes of the problem. Although dismal performance in these subjects had almost been accepted as the norm in some schools, the Ministry of Education Science and Technology (MOEST) and other stakeholders felt there had to be an intervention, hence the SMASSE project.

The SMASSE team conducted a baseline survey in the nine pilot districts (Kajiado, Gucha, Kakamega, Lugari, Butere- Mumias, Kisii, Muranga, Maragua and Makueni) with additional six districts (Meru South, Kilifi, Taita-Taveta, Baringo, Kiambu and Garissa) being brought on board in the year 2001 after mid-term evaluation of the project. The survey was to determine the areas that needed intervention and come up with a strategic plan of operation. Upon the end of Phase I, in May 2003, Phase II was launched to cover the whole country.

The INSET programme was organized into four cycles of ten days each with the following INSET objectives:

1) Cycle one targets attitude change,
2) Cycle two targets ASEI planning and hands-on activities with bridging,
3) Cycle three targets actualization and practice in the classroom,
4) Cycle four targets students' growth and impact transfer.

In this study, the impact of SMASSE INSET on students' attitude and performance in mathematics in secondary schools was chosen because, before the implementation of the SMASSE project, the students used to have a negative attitude towards mathematics as revealed by poor performance in KCSE Examinations (KNEC, 1998).

2. Statement of the Problem

The fields of technological and professional education require a strong foundation consisting of sound background knowledge of mathematics. Thus, mathematics is of necessity a strategic subject and a prerequisite for studying science and technology. As technology develops and reaches more and more into all levels of industry and commerce, so more mathematics will be needed at all these levels.

The government acknowledges the importance of mathematics. It is consistently emphasizing the study of mathematics at all levels. In fact, mathematics is one of the compulsory subjects at both primary and secondary school levels (KIE Syllabus, 2002).

Students in higher levels of education are also encouraged to study some mathematics as a necessary prerequisite for such subjects as physics, chemistry, economics, engineering and others.

The Kenyan government has been working to improve science and mathematics education in primary and secondary schools, which has been set as a major challenge from the perspective of developing human resources capable of promoting industrialization. For five years since July 1998, Japan has been extending support in training in-service teachers for science and mathematics in pilot regions of Kenya (SMASSE1). Based on the achievement of SMASSE I, SMASSE II has been implemented to cover the whole country since July 2003 as a five-year project.

The overall research problem addressed in this study is that despite the launching of the SMASSE INSET to cover the whole country in the year 2003, the performance of secondary school students in mathematics at KCSE level has been very low as shown in Table 1.1(P.6). This prompted the researcher to investigate the impact of SMASSE INSET on students' attitudes and performance in Mathematics Bomet District.

Table 1.1: KCSE Mathematics results analysis

Year	Candidature	Mean score (%)
2005	259280	19.69
2006	238684	19.04
2007	273504	18.23
2008	304908	21.30
2009	335615	21.13
2010	356072	23.04
2011	409887	24.79
2012	433017	28.66
2013	444774	27.58
2014	481286	24.02
2015	520274	26.88

Source: KNEC, 2015.

The current study therefore endeavours to establish whether the SMASSE INSET has had any impact on attitude change and improved performance in mathematics in secondary schools in Bomet District.

2.1 Purpose and Objectives of the Study

The main purpose of this study was to investigate the impact of SMASSE INSET on students' attitude change and performance in mathematics in secondary schools in Bomet district.

The objectives of this study were:

1) To establish whether SMASSE INSET has changed the students' attitudes toward mathematics
2) To find out whether SMASSE INSET has improved performance in mathematics
3) To determine whether SMASSE INSET has improved the teaching approaches and methodology

2.3 Research Design and Methodology

This study adopted a descriptive survey design. According to Gay (1981), descriptive research is a process of collecting data in order to test hypotheses or to answer questions concerning the current status of the subjects in the study. Descriptive survey designs are used in preliminary and exploratory studies to allow researchers to gather information, summarize, present and interpret for the purpose of clarification (Orodho, 2002). Borg and Gall (1989:5) note that descriptive survey research is intended to produce statistical information about aspects of education that interest policymakers and educators. The survey research was therefore useful because of the economy of taking a sample of the population to generalize results for the whole population.

A descriptive survey design was employed because it guarantees breadth of observation and also provides for the accurate descriptive analysis of characteristics of a sample which can be used to make inferences about the population (Popham, 1967; Kerlinger, 1973).

Descriptive survey is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals (Orodho, 2003). It can be used when collecting information about people's attitudes, opinions, habits, or any of a variety of education or social issues (Orodho and Kombo, 2002). For example, teachers in schools can carry out a survey to find out student's attitudes toward their teaching styles or discipline.

Bomet district has 97 secondary schools with a student population of 15,556. There are 5 boys', 8 girls' and 84 mixed secondary schools all distributed in the six divisions of Bomet district (MOEST, 2007).

A sample of 30% of the schools in the district was selected for the study. The study however covered all the six divisions of Bomet District.

The schools in the six divisions were categorized into boys' boarding schools, girls' boarding schools and mixed schools. Thereafter, schools from each of the three categories were randomly selected.

To calculate the number of sampled schools by category, the total number of schools in each category was multiplied by the ratio of schools sampled to the total number of secondary schools in the county. Therefore from 27 schools to be sampled, 2

boys, 3 girls and 25 mixed schools were selected. This was done to ensure that there is an adequate representation of the different categories of schools.

The sample of the study was drawn from four students. It was assumed that the form four students would be more mature in their opinions and attitudes toward mathematics. A sample of 375 students was used comprising of girls and boys from boys' boarding schools, girls' boarding schools and mixed schools.

The researcher also gathered information from mathematics teachers of the schools that participated in the study. Their information was hoped to strengthen the validity of the results. A total of 27 mathematics teachers and 27 heads of the mathematics department were selected for the interview.

In the study, the following instruments and techniques were used.

a) Student's Questionnaire (SQ);
b) Teacher's Questionnaire (TQ);
c) HOD Mathematics Questionnaire.

3. Summary of Major Findings

The first research question was: *does SMASSE INSET have any impact on students' attitudes toward mathematics?* The analysis of the responses to the questionnaire test items shows that there is a marked improvement of students' attitudes after SMASSE INSET.

Table 1: An analysis of students' attitude towards mathematics by school category

Item number	Statement	School category	N	Mean $\bar{x}$
1	Mathematics is very interesting to me and I enjoy my mathematics course.	Boys' school	82	4.205
		Girls' school	110	4.500
		Mixed school	179	4.369
2	My mind goes blank and I am unable to think clearly when doing mathematics.	Boys' school	82	4.354
		Girls' school	110	4.164
		Mixed school	179	4.257
3	If I am confronted with a new mathematics situation, I can cope with it because I have a good background in mathematics.	Boys' school	82	4.073
		Girls' school	110	3.927
		Mixed school	179	3.363
4	I can draw upon a wide variety of mathematical techniques to solve a particular problem.	Boys' school	82	3.939
		Girls' school	110	3.982
		Mixed school	179	4.067
5	I do not feel that is have a good working knowledge of the mathematics course I have taken so far.	Boys' school	82	4.183
		Girls' school	110	4.027
		Mixed school	179	3.950
6	I learn mathematics by understanding the underlying logical principles, not by memorizing the rules.	Boys' school	82	4.037
		Girls' school	110	4.164
		Mixed school	179	3.821
7	If I cannot solve a mathematics problem, at least I know a general method of attacking it.	Boys' school	82	3.500
		Girls' school	110	3.709
		Mixed school	179	3.324

8	Mathematics problems are a challenge, solving problems provides satisfactions similar to those of winning a battle.	Boys' school	82	4.244
		Girls' school	110	4.164
		Mixed school	179	4.201
9	I have more confidence in my ability to deal with mathematics than in my ability to deal with other academic subjects.	Boys' school	82	3.134
		Girls' school	110	3.445
		Mixed school	179	3.307
10	Mathematics classes provide the opportunity to learn values that are useful in other parts of daily living.	Boys' school	82	4.378
		Girls' school	110	4.500
		Mixed school	179	4.313
11	Mathematics is a very difficult subject to study in school.	Boys' school	82	4.561
		Girls' school	110	4.600
		Mixed school	179	4.385
12	People who have studied mathematics get good jobs.	Boys' school	82	4.354
		Girls' school	110	4.555
		Mixed school	179	4.212
13	Mathematics requires thinking, not just memorizing terminologies formulae and concepts.	Boys' school	82	4.646
		Girls' school	110	4.564
		Mixed school	179	4.324
14	Mathematics is one of the easiest subjects.	Boys' school	82	3.585
		Girls' school	110	4.018
		Mixed school	179	3.816
15	Mathematics develops critical thinking in solving problems.	Boys' school	82	4.634
		Girls' school	110	4.536
		Mixed school	179	4.458

The findings revealed that even though the general attitude of the students towards mathematics has improved, there are areas that need some further improvement.

Quite a number of the students in boys' boarding schools, girls' boarding schools and mixed schools do not have more confidence to deal with mathematics than in their ability to deal with other academic subjects. The majority of the students have not developed good mathematical problem-solving skills since most of them expressed their inability to deal with new unfamiliar mathematical problems.

The findings also revealed that students in girls' boarding schools had a marked improvement in terms of their attitude towards mathematics as compared to students in boys' schools or mixed schools. The school setting which reinforces the fear of mathematics in girls should attempt to remove this fear. Teachers need to constantly point out that learning mathematics is not a function of sex and that girls are entering into the previously male-dominated field like engineering architecture, medicine and others. Only then we can completely shatter the myth of mathematics as a male affair.

The results from this study suggest the need for teachers to develop positive relations with students, to stress classroom activities that involve active teaching /learning process and to engage students meaningfully in mathematics, so that a fruitful and satisfying result is assured.

The second objective of the study was: *to determine whether SMASSE INSET has improved performance in mathematics.* Using the one-way ANOVA or t-test, the study

revealed that, overall, there is no significant difference between SMASSE INSET and mathematics performance.

Table 2: One-way ANOVA for KCSE results before SMASSE and after SMASSE

		Sum of squares	Df	Mean Square	F	Sig.
Boys' results	Between groups	638.021	1	638.021	.529	.471
	Within groups	55469.792	46	1205.865		
Girls' results	Between groups	5250.083	1	5250.083	4.672	.036
	Within groups	51695.833	46	1123.822		
Mixed schools' results	Between groups	768.000	1	768.000	.702	.406
	Within groups	50293.917	46	1093.346		
Overall results	Between groups	16837.521	1	16837.521	3.160	.082
	Within groups	245109.0	46	5328.456		

However, when the performance of girls' schools was analyzed using one-way ANOVA or t-test, the study revealed that there is a significant difference between SMASSE INSET and mathematics performance, at 0.05 significant levels. This implies that girls' schools never benefited from SMASSE INSET more than boys' schools or mixed schools in terms of improved performance. As expected, the SMASSE INSET was supposed to result in an improved performance in mathematics.

The third objective of the study was: *to determine whether SMASSE INSET has improved the teaching approaches and methodology.* The study revealed that there is a general improvement in the teachers' teaching approach and methodology after undergoing the SMASSE INSET.

Table 3: An analysis of students' understanding about teaching in the classroom as per school category

Item number	Statement	School category	N	Mean $\bar{x}$
16	Mathematics teacher starts a lesson by reminding us of what was taught in the previous lesson.	Boys' school	82	4.268
		Girls' school	110	4.318
		Mixed school	179	4.536
17	Mathematics teachers explain what is to be covered during the lesson.	Boys' school	82	4.000
		Girls' school	110	4.200
		Mixed school	179	4.045
18	Mathematics teachers usually demonstrate to help explain some ideas and concepts.	Boys' school	82	4.256
		Girls' school	110	4.373
		Mixed school	179	4.240
19	Mathematics teachers adequately guide us in the use of mathematics materials and resources.	Boys' School	82	4.293
		Girls' School	110	4.318
		Mixed school	179	4.385
20	Mathematics teachers use the locally available materials to teach us mathematics.	Boys' school	82	3.939
		Girls' school	110	4.182
		Mixed school	179	3.911
21	Mathematics teachers give us experiments / practical activities when teaching us mathematics.	Boys' school	82	3.671
		Girls' school	110	3.564

		Mixed school	179	3.575
22	Mathematics teachers use our ideas and suggestions when teaching.	Boys' school	82	3.768
		Girls' school	110	3.482
		Mixed school	179	3.134
23	Mathematics teachers assist us in group work.	Boys' school	82	3.707
		Girls' school	110	4.218
		Mixed school	179	4.078
24	Mathematics teachers allow us to do work on the chalkboard.	Boys' school	82	4.463
		Girls' school	110	4.227
		Mixed school	179	4.045
25	Mathematics teachers give a summary of what has been taught in the lesson.	Boys' school	82	3.927
		Girls' school	110	4.082
		Mixed school	179	4.168
26	Mathematics teachers assist students with difficulties in understanding.	Boys' school	82	4.232
		Girls' school	110	4.236
		Mixed school	179	4.162
27	Mathematics teachers mark assignments.	Boys' school	82	3.927
		Girls' school	110	4.145
		Mixed school	179	4.162
28	Mathematics teachers involve students when answering our questions.	Boys' school	82	4.134
		Girls' school	110	4.073
		Mixed school	179	3.799
29	Mathematics teachers encourage us to perform well.	Boys' school	82	4.707
		Girls' school	110	4.736
		Mixed school	179	4.654
30	Mathematics teachers like and enjoy teaching the subject.	Boys' school	82	4.512
		Girls' school	110	4.655
		Mixed school	179	4.492

The study also revealed that even though there is a general improvement in the teacher's teaching approaches and methodology, there are areas that need urgent corrective measures. Quite a number of the students pointed out that their mathematics teachers do not give them experiments or practical activities when teaching mathematics.

Teachers should embrace the ASEI/ PDSI approach to teaching mathematics. The teacher in the classroom should spend more time preparing his/her lesson, taking into account students' mathematical background in terms of cognitive development and language level. As the teacher plans his/her lesson, he/she must also consider the resource materials he/she will use and the applicability of the teaching aids to be used. Teaching should be in steps, the lesson building up with students actively involved. Illustrations, examples and demonstrations should be given in relation to the experiences and the environment of the child. Mathematics teachers should endeavour to prepare many resource materials for learning. Teaching aids may not be useful unless they are properly integrated into a lesson. They are most useful if the learners make their own models using given instructions.

Out of all the teachers who were involved in the study, 85% were males whereas only 15% were female teachers. Eighty-five percent (85%) of the teachers interviewed

attended all four cycles of SMASSE INSET, 10% only attended one cycle whereas 5% attended three cycles.

From the questionnaire and interviews conducted the teachers pointed out that they were impressed by the following:

1) Actualization-planning and teaching as a group,
2) Practical approach to teaching mathematics,
3) Opportunity to share experience with colleagues,
4) Improvisation of teaching/ learning resources.

After undergoing SMASSE INSET teachers noted that they now put a lot of effort in the teaching of mathematics though there is minimal increase in performance. Some suggested that they now put a lot of effort into their teaching since the attitude of students has improved.

There is now full participation of the learning process by the students. 90% of the teachers pointed out that there is a difference between a teacher who has undergone SMASSE INSET and one who has not. SMASSE-compliant teachers can come up with hands-on activities that call for students' participation and involvement in the teaching/ learning process. Ten percent (10%) of the teachers noted that there is no difference between a teacher who has undergone SMASSE INSET and one who has not because the teacher's attitude may not have been changed by the INSET.

Teachers suggested the following measures for improving and sustaining the SMASSE INSET:

1) Motivation of trainees financially by giving them allowances.
2) Newly employed teachers should be in-serviced from cycle 1.
3) Good accommodation should be provided for the trainees.
4) SMASSE INSET should be done outside the home district
5) SMASSE should be incorporated into the curriculum in teacher training colleges and institutions.
6) Improve recognition certificate by taking proficiency exams at the end of the SMASSE INSET.
7) Symposiums for mathematics teachers should be held regularly.

Teachers suggested the following considerations to be put in place when planning for some of the mathematics in-service courses in the future:

1) Involve teachers since they are the agents of change,
2) Exchange of trainees from different places other than the ones from the home district,
3) Areas of difficulty for students should be identified in advance,
4) Create more INSET centres and equip them,
5) Teachers willing to attend the in-service should apply instead of being made to be mandatory for all the mathematics teachers to attend.

4. Recommendations

From the research findings and interviews conducted, the following are recommended:

1) Since SMASSE INSET is a very important innovation, there is a need to incorporate the whole of SMASSE programme into the curriculum at teachers training colleges and universities. Fresh graduands should be SMASSE compliant as they leave their training institutions. INSET should only be introduced as a way of sharpening and reinforcing the teacher's skills and competencies in teaching mathematics.
2) The Teachers Service Commission should employ more mathematics teachers. Full SMASSE implementation is very demanding on the side of the teachers. Teachers do not give regular assignments in mathematics owing to the large number of students. The idea of every teacher having a minimum of 27 lessons per week is not applicable to mathematics and sciences. These subjects demand a lot of adequate preparation and planning. When the teacher is overloaded, there are few preparations expected from such a teacher. Moreover, the idea of marking students' work on a daily basis is not possible.
3) The one ingredient most likely to have an impact on students' learning is the quality of teaching. Curricular and pedagogical changes in mathematics depend on teachers becoming the agents of reform, rather than the targets. This means that rather substantial resources need to be invested in the professional development of teachers. Teachers need to experience the new curriculum themselves. Also, model teaching in the seminars enhances implementation in the teacher's classroom. Teachers need to see demonstration lessons with real students. Otherwise, they are and will remain skeptical, seeing it work enhances successful implementation. They have a right to be part of developing or adapting material for their classrooms. A sense of ownership and pride that goes with it is important.
4) Teachers themselves should be given primary responsibility for the improvement of their classroom practice. They should be made to own the in-service course instead of being coerced and threatened with interdiction in case they fail to attend the INSET. Teachers should not be assumed to be competent once they have completed their pre-service teachers' training programmes. Participation in frequent school-based professional development groups should be considered as part of the teachers' job. These groups should not only provide a context in which teachers are mentored and trained but also provide for the development and testing of new teaching techniques and methodology.
5) The teaching of mathematics is likely to be more efficient if the schools develop their own mathematics laboratories. Mathematics laboratories should be allocated for mathematics teaching and also for students' own investigative activities in mathematics concepts. In schools, a classroom should be set aside as a mathematics laboratory by equipping it with mathematical tools such as geometrical instruments, models, projectors, calculators, and computers, etc. The

change from students passively learning mathematics to students performing mathematical activities requires the use of mathematics tools which need to be conveniently placed in a laboratory for easy access.

5. Suggestions for Further Research

This study could not exhaust all about the impact of SMASSE INSET on students' attitude and performance in mathematics. More research is recommended to supplement data from this study. The following are areas that need further research:

1) Since the present study was limited to secondary schools in Bomet District, similar studies could be carried out in other districts. This present study might be a pointer in such a direction.
2) This study could also be replicated using other academic subjects such as physics, chemistry and biology.
3) Research should be done to establish the relationship between mathematics preparation in primary schools on the subsequent study of mathematics in secondary and higher levels of education
4) Research should also be done on the effects of parent's/guardian's attitudes towards mathematics on the performance of their children in mathematics.
5) Further research is needed to investigate whether all the major steps of any innovation were considered before the SMASSE INSET was implemented to cover the whole country.
6) Further research is also needed to investigate the effect of the teacher's gender on the performance of students in mathematics.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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