

## THE EXTENT TO WHICH TEACHERS OF MATHEMATICS AND CHEMISTRY HAVE EMPLOYED USE OF ASEI AND PDSI APPROACHES FOR SMASSE IN SCHOOLS

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**ABSTRACT:** *Adequate pre-service training notwithstanding, the real teacher is generally formed in the classroom through experience and further training. This calls for the In-service Education Training (INSET) which provides opportunity for teachers to share experiences and mentor each other in order to update their skills and interact with innovative approaches and practices that create interest and inspire confidence in teachers. This is the basis for the Strengthening Mathematics and Science in Secondary Education (SMASSE) project in Kenya. SMASSE training was initiated aiming at developing the competencies of teachers through the Activity, Student-centered, Experiments and Improvisation (ASEI) and Plan, Do, See and Improve (PDSI) approaches. This paper is an investigation into the SMASSE project to establish the extent to which teachers of Mathematics and Science subjects have made use of the two approaches. A total of sixteen schools were selected using the stratified random sampling method. Data analysis for both qualitative and quantitative data was done using Statistic Package for Social Sciences (SPSS) software, Registered R and Excel. Findings are presented using percentages, trend lines, frequency distribution and means. The study results showed that the ASEI/PDSI approaches are in use and have improved the teachers' confidence and ability to deliver, and the skills learnt are effective. The teachers are now more confident in teaching and more consistent in the use of the ASEI/PDSI approaches after the INSET. The frequency of use, the decision of the approach to use and the extent of use of the approaches are based on personal discretion. The study does not, however, clearly distinguish the difference in use of the ASEI/PDSI approaches pre and post-SMASSE INSET. The research recommends that future SMASSE programmes should have a bottom up approach to enable full ownership by stakeholders.*

**KEYWORDS:** ASEI, PDSI, SMASSE, In-service Education Training, Frequency.

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### INTRODUCTION

#### ASEI/PDSI approaches in SMASSE

The Kenyan government has adopted Science, Technology and Innovation (STI) as a tool for the attainment of its industrialization and vision 2030 (GOK, 2008). This implies that success in mathematics and science subjects is central to the attainment of these goals. However, poor performance in mathematics and science subjects in secondary education has been a major concern in our education system. SMASSE INSET emphasizes the practice of Activity, Student-centered, Experiment and Improvisation (ASEI) and Plan, Do, See, Improve (PDSI) approaches. The ASEI/PDSI approach aims at equipping teachers with necessary skills for classroom practices that are activity oriented in order to create an opportunity for learners to take responsibility for their own learning. It encourages teachers to practice student-centered teaching and learning. Emphasis is laid on employing inquiry-based and problem solving learning as opposed to lecture style and recipe-type approach to experiments. Improvisation is

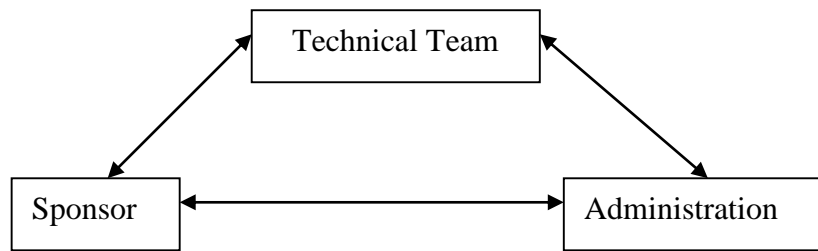
encouraged not only to augment conventional equipments, apparatus and materials but also to arouse interest and curiosity among the learners. Such practices encourage teachers to draw content and examples from the learners' real life experience in order to capture their interest and imagination in science and mathematics. The other aim is to foster teachers' ability and appreciation for the work planning and systematic execution of the teaching and learning process.

Thuku (2003) noted that in general, teachers in different countries have different needs and therefore INSET may have different purposes. According to UNESCO (1983) INSET is the whole range of activities by which serving teachers and other categories of educationist with formal school system may extend and develop their competence, and general understanding of the role which they and their schools are expected to play in their changing societies. JICA (2000) also notes that the INSET enhances the performance of teachers. Guthrie and Reed (1991) in their support to in-service training note that this kind of training is concerned with the acquisition of specific skills or knowledge of certain procedures which may be a building block within the broader context of staff development.

Teachers need to be provided with opportunities for professional development through INSET where they share experiences, mentor each other, update their skills and interact with innovative approaches and practices that create interest and inspire confidence in the learners (ADEA, 2005). This is the case with SMASSE INSET.

The SMASSE INSET provides a forum for mathematics, biology, chemistry, and physics teachers in secondary schools to gain new ideas, revise their knowledge on subject matter, pedagogical issues, curriculum development and any other aspects that would improve their professional competence. INSET therefore helps teachers overcome the profound intellectual and professional isolation that many times teachers face and feel themselves in, in their daily activities (UNESCO, 2006). INSET can only be said to have had an impact or effect if there is organizational translation of professional development into improved classroom learning and pupil's performance (Rhodes & Houghton-Hill, 2000).

The principles of ASEI/PDSI approach serve as a foundation upon which teachers can build a substantive and sustainable change in classroom practices with the ultimate aim of enhancing the quality of teaching/learning of mathematics and science (SMASSE, 2007). SMASSE INSET has been institutionalized both at national and district levels. Sustainability of the programme is guaranteed because the government through the Ministry of Education Science and Technology (MOEST) is committed to the provision of adequate funding for all the programme activities through monies mobilized through the sponsors. MOEST remits an annual budget allocation to the Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA) to run national INSET activities. It has also made provisions for district INSET activities to be funded from the Free Secondary Education (FSE) Funds disbursed to schools every year (MOEST, 2008). Harnessing of human resource for the SMASSE INSET adopts what is known as the SMASSE triangle using the structure shown in figure 1.



**Figure 1: SMASSE structure**

*Source: Handbook on management of district SMASSE programmes, (2008)*

Administration consists of MOEST officials, CEMESTEA leadership, school principals and representatives of District Trainers. This team is charged with formulating SMASSE programme and overseeing the implementation of the policies. The technical team comprises selected teachers who demonstrate competence in carrying out their duties and responsibilities, and commitment to their own professional development and that of their colleagues. Upon training these teachers act as the technocrats in implementation of programme activities. Sponsors, as mentioned earlier comprise of Japan International Cooperation Agency (JICA), Government of Kenya (GOK) through MOEST and funds for Free Secondary Education (FSE).

Even with teacher training in SMASSE, improvement in students' performance in national examinations, particularly Kenya Certificate of Secondary Education (KCSE), is yet to be investigated. Though teachers appreciate the importance of ASEI and PDSI principles, some have expressed fears that it is difficult to implement. The approaches require a lot of time in planning and implementation and calls for extra effort on the part of the teacher. The implementation of the student-centered approach requires more time. Full application of the same slows down the teacher in syllabus coverage at a time when they are dealing with ever increasing pressure to complete the syllabus. This makes it needful to establish the extent to which these principles are in use.

Performance of science subjects in our national examinations has been below average over the years. Many students fail to get to tertiary science based institutions especially due to failure in mathematics and chemistry in their KCSE exam.

## **MATERIALS AND METHODS**

This study was carried out in secondary schools in Kikuyu District in Central Province. The study utilized a cross-sectional approach representing a snapshot of one point in time and descriptive design (Jupp, 2009) seeking to determine the extent to which SMASSE training in dissemination, understanding of mathematics and chemistry has been used and the actual performance in KCSE. According to Kombo and Tromp (2006) the major purpose of descriptive research is description of the state of affairs. The study focused on both public and private secondary schools in the district. The schools should have sat for the KCSE since 1999 a time before SMASSE was initiated in the district. The schools were sampled by stratified random sampling from the total number of national, provincial, district and private secondary schools in the district

A sample size of sixty percent of the secondary schools in Kikuyu district as at December 1999 was obtained using the following formula:

$$\frac{\text{Total number of schools in the stratum (N)}}{\text{Total number of schools in the district (T)}} \times 60\% = 16 \text{ schools}$$

Thus a total of 16 schools were included in the study. Schools in each stratum were listed down after which a table of random numbers was used to randomly select the schools to be included in the sample. Data collection was performed by use of questionnaires, review of available documents, and focus group discussions. Data analysis was done both qualitatively and quantitatively.

Inferential statistics was used in making deductions and generalizations about the whole population. The inferential statistics was tested at  $\alpha < 0.05$  significance level. Data presentation was done using, graphs and narratives.

Regression was also used to compare mean performance of students for 1999-2000 (before SMASSE INSET started) and 2004-2008 that comprises the years the teachers went through the four- cycle SMASSE INSET.

## RESULTS AND DISCUSSION

### Social – Demographic Data

Questionnaires were delivered in the sixteen schools that had been sampled. Out of these, one school did not respond. This meant that 94% (n=16) schools were included in the study. Among the schools studied 6.67% (n=15) were national, 13.33% provincial, 53.33% district schools and 26.67% were private schools. In the schools that responded, one teacher did not respond giving a total of 3.3% (n=30) non-response.

About three quarters (65.5%, n=29) of the teachers who responded were males while the rest were females. The case was different for the principals with almost a 50: 50 representation of males and females. More than half (58.6%) of the teachers interviewed were aged between 30-39 years while the rest were equally distributed between the ages of 20-29 and 40-49 years. The case was different for the principals with more than a half (53.3%, n=15) being age 40-49 and the rest evenly distributed between ages 30-39 and above fifty. Most of the principals (86.7%, n=15) had been in the teaching profession for more than eleven year and about a half (46.7%, n= 15) of them had been in that position for less than five years. For the teachers, more than a half (55.2%) had been in the same station for more than five years.

More than two thirds (68.9%) of the teachers were holders of bachelor of education while 17.2% and 10.3% were holders of diploma in education and post graduate diploma in education respectively. The case was not different for the principals as more than a half (60%, n=15) were holders of bachelor of education while 20% and 13% were holders of post graduate diploma and masters degree respectively. Most of the teachers (62.1%, n=29) had been in the teaching profession for more than ten years while only 17.2% had been in the profession for less than five years.

Of the teachers interviewed, all of them had attended SMASSE INSET. Majority, 86.2% taught either chemistry or mathematics as their main teaching subject. They also had attended

SMASSE INSET in these subjects. The rest had another science subject as their main teaching subject and attended SMASSE INSET for the other subject. More than three quarters (86.2%) attended SMASSE INSET as trainees while the rest were district trainers. Only one principal was a district trainer. While only 26.7% of the principals had mathematics or chemistry as their main teaching subject, about a half (46.7%, n=15) had attended the normal SMASSE INSET. The rest of the principals had attended a shorter course on SMASSE for the principals.

### Use of SMASSE ASEI/PDSI Approach by the Teachers

A number of teaching activities advocated for by SMASSE are adequately in use by the teachers as shown in figure 2 below. This is because more than 80% of the teachers at least utilize them during some lessons. The teachers however commented that they have always used these activities even before initiation of SMASSE. This was the case with inviting questions from students during or after the lesson, evaluation of students understanding of a concept, engaging students in project work, assigning students practical work during the lesson, assigning students' discussion work during the lesson and engaging students in group work. This is however not the case for some of the recommended activities. Less than 20% of the teachers invited other teachers to observe their lessons as they teach. This activity, followed by use of both lesson plan and lesson notes in class, which only occurred among less than 60% of the teachers at least in some lessons, and making lesson plans, which occurred at least in some lessons for less than 70% of the teachers are the least utilized.

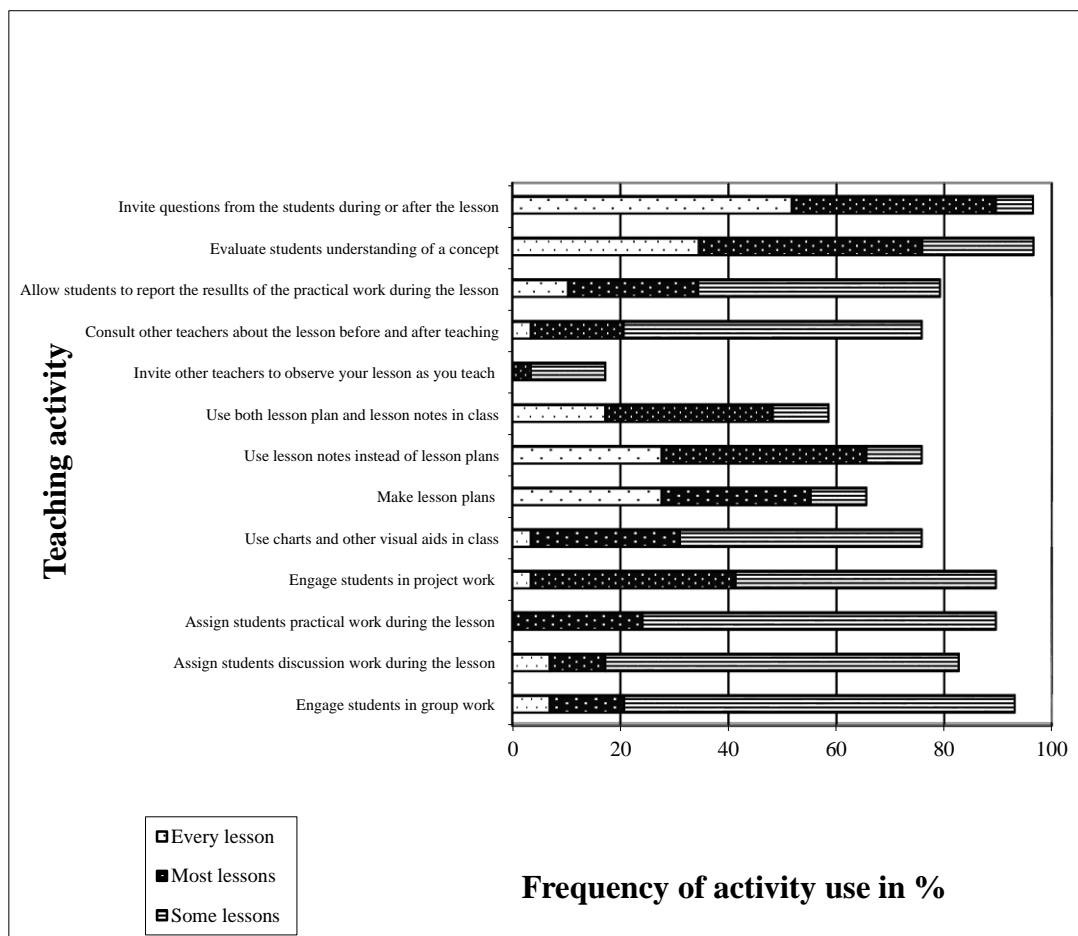


Figure 2: Teaching activity and their frequency of use

The results in figure 2 above implied that the teachers make use of ASEI/PDSI approaches that seem convenient and more applicable within the circumstances. For the approaches that they do not agree to, they do not apply them even if recommended by the SMASSE program. This conforms to Kagenyi (2008) who noted that though students are exposed to hands-on experience especially during practical lessons, teachers' attitude has not changed as expected.

In the use of ASEI/PDSI concepts by the teachers the study established that 80% of the teachers use these approaches during some lessons but on very rare cases (20%) of the teachers responded positively to inviting other teachers to observe their lessons as they teach. Both teachers of mathematics and chemistry were in agreement that the skills learnt in SMASSE INSET were effective and applicable in teaching the two subjects. The principals concurred with this opinion, 60% agreeing that the INSET has been useful and 53.3% saying teachers were more effective in their teaching. In all, principals, teachers and students were in agreement that SMASSE INSET caused teaching to be more effective.

Use of most of the recommendations on ASEI/PDSI approaches in teaching was evident in the study. However there were some recommendations that were hardly executed. This was the case with invitation of other teachers to observe another's lesson. In a focus group discussion, students confirmed that such a practice does not occur. The teachers noted that the ASEI/PDSI approaches are not very different from what the practice had been at pre-SMASSE but they are now more confident in teaching and consistent in using the approaches. More value is placed on practices that the teachers deem valuable and convenient within the settings.

## CONCLUSION

SMASSE's ASEI/PDSI approaches are in use by teachers of mathematics and chemistry as had been traditionally the case before SMASSE INSET. However, the teachers are now more confident in teaching and more consistent in the use of the ASEI/PDSI approaches after the INSET. The frequency of use and the decision of the approach to use and the extent to which the approaches are applied are based on personal discretion. The study does not however clearly distinguish the difference in use of the ASEI/PDSI approaches at pre and post-SMASSE INSET.

## RECOMMENDATIONS

The study recommends that a study be carried out on the effect of SMASSE INSET on teachers' attitude towards teaching concepts using the ASEI/PDSI approaches.

Researchers also need to look into the factors affecting teachers' attitude towards teaching in secondary schools.

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