



Do SMASE Training Methodologies get their way into the Classroom? Interrogating the Kenyan Biology Classroom Environment

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Abstract: *Strengthening of Mathematics and Science in Education (SMASE) is an In-service Education and Training (INSET) that was initiated to address the perennial poor performance in mathematics and sciences. The INSET aimed at transforming classroom interactions from teacher-centred to learner-centered so as to improve learner academic achievement that had been poor. The present study therefore sought to establish whether the SMASE-trained biology teachers practice the tenets of SMASE. The study was guided by two objectives: To find out the teaching methodologies used by SMASE-trained biology teachers and to determine whether the biology trained biology teachers' lessons have a bias on biology process or content. The study was conducted in Emuhaya Sub-county in Vihiga County. The respondents included all the SMASE-trained biology teachers in the sub county. The data collection instruments included: Biology Teachers Questionnaire (BTQ), Interview Schedule and Biology Teachers Observation Schedule (BTOS). Data was analysed by use of descriptive statistics and content analysis. It was found that biology lessons were biased towards content with the common methods used during SMASE training and during biology classroom instruction are lecture, question answer, discussion and demonstration. The conclusion made is that there is minimum use of learner-centred teaching methodologies both during training and during classroom biology instruction. It is recommended that the INSET organisers should be pragmatic by practicing the learner-centered methodologies during training so as to enhance teacher-trainee emulation. The findings of this study will inform the SMASE organisers on the adoption of appropriate training approaches.*

Keywords: Biology Teacher, Methodology, Performance, SMASE INSET, Vihiga,

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1. Introduction

In-service education and training (INSET) for teachers is a crucial component of teacher development in the teaching profession globally. According to Ngirwa (2009) the concept of INSET concerns the obtaining skills, knowledge and attitudes among employees in order to perform their job better for the achievement of their institutional goals and objectives. Serapion (2018) supports this position by arguing that INSET is the bridge between job requirements and employee present

specifications. This involves changing what employees know, how they work, or their attitudes towards their jobs and organizations. Such INSET training refers to the process by which teachers get skills, attitudes and knowledge through indoor or outdoor programmes. The failure of an INSET to achieve its set objectives can either be attributed to the INSET itself or the teacher trainees' failure to implement the tenets of the training (Kayapinar, 2016). Strengthening of Mathematics and Science in Secondary Education (SMASSE) INSET having been implemented in Japan, showed great success lessons worth emulation. The programme has been initiated and

rolled out in over ten African countries (SMASE, 2020). Kenya is one such country where the SMASE INSET has been rolled out for decades now.

SMASSE as an INSET was initiated in Kenya on 1st July 1998. This was after poor performance had been witnessed in mathematics and sciences in Kenya Certificate of Secondary Education (KCSE) examinations over years. The national trainers' team then conducted a baseline study to find out the factors causing poor performance and participation in mathematics and sciences in secondary schools (Kibe, Odhiambo & Ateng'Ogwel, 2008). Among the factors found contributing to poor performance in sciences and mathematics were: negative attitude, lack of appropriate teaching methodologies, poor mastery of subject content, inadequate assignments to students and infrequent inspection. SMASSE therefore came in handy with a package of In-service Education and Training (INSET) to address these factors since most of them were teacher-based factors (SMASE, 2020).

SMASSE programme was initiated through the partnership between the Kenyan Government through Ministry of Education (MOE) and Japan government through, Japan International Cooperation agency (JICA) (SMASSE, 2007; Imanda, 2013; SMASE, 2020). In recent years, the programme was rolled down to primary school level so as to create a better foundation in science for learners in primary school. This led to the programme being renamed as Strengthening of Mathematics and Science in Education (SMASE). Therefore the renaming was to accommodate not only secondary school teacher INSET but also primary school level. The role of secondary education and that of mathematics and science in industrial and technological development of a nation is well documented. The Dakar conference of 2000 was concerned with the quality of education and emphasized education for all by 2015 since the United Nations (UN) had declared education a human right (Njiru, 2012; COMSTEDA, 2020). However as at now, this objective has not been attained post-2015. Therefore, there is need to interrogate one of the programmes (SMASE) that was anticipated to contribute to the fruition of this intent. SMASE INSET is conducted at two levels; national and County level. At national level, the national trainers facilitate INSET for County trainers, who in turn train all the other mathematics and science teachers in their respective Counties throughout the country (Imanda 2013; Ameka & Nyakwara, 2020). Since the outbreak of the COVID-19 pandemic in the year 2020, the INSET is conducted through virtual platform with minimum or no in person training sessions.

Of all the factors under control of the school, teaching has the most demonstrable impact upon student achievement (Bostwick, 2009; Imanda, Okwara, Murundu & Bantu, 2014; Kayapinar, 2016). The teacher is the most important factor in teaching that if varied, can influence school

output positively. The teacher has at his disposal many methods from which to choose the most appropriate one to use in teaching. The choice of the method to be used in teaching will depend on the skill or information the teacher wishes to convey (Kayapinar, 2016). Good teaching practices learnt in college are soon undone when one gets into the profession due to lack of follow-up. Very soon after joining the teaching profession, newly trained teachers resort to outdated teaching practices most likely due to discouragement directly or indirectly by veteran colleagues (Serapion, 2018). INSET therefore provides an opportunity to follow-up what was learnt during pre-service training. There is need for an education system to conform to the needs of the learner and society (Nyakangi, 2021). To this end the classroom environment should provide room for learner engagement which will result into learner adaptability to the changing needs in the society.

The teaching method to be used is the task of the teacher and he should be guided by all basic components of objectives of the lesson, class and individual learner, holistic environment, learning activities and expected outcome. During classroom observation they found out that most lessons were conducted through the lecture method with very little or no learner participation (SMASSE, 2007; SMASE, 2020). This meant retraining was fundamental for these teachers. The above studies are similar to the present study since both were looking for teaching methods used during science teaching. However, the studies were conducted before SMASE inception while the present study sought to find out the teaching methods used by SMASE-trained biology teachers.

Appropriate methodologies as emphasized in SMASE INSET are a precursor to learner engagement which is a key attribute of Competence Based Curriculum (CBC). Nyakangi (2021) observe that CBC emphasises learner engagement rather than learner involvement. The key components of CBC are learner competencies. It is along such conformity that the present study aimed at finding out whether the biology teacher practice the methodologies that they learn during SMASE INSET. Nyakangi further notes that CBC is anchored on seven core competencies. Among the seven are: communication and collaboration, imagination and creativity, problem solving creativity and, learning to learn. These competencies are well acquired and practiced through practical hands on activities. By teachers implementing the SMASE teachings the competencies will ultimately be achieved.

1.1 Objectives of the Study

The following objectives guided the study:

- To find out the teaching methodologies used by SMASE-trained biology teachers
- To determine whether the biology trained biology teachers' lessons have a bias on biology process or content.

1.2 Statement of the Problem

A great investment has been put in place by the government of Kenya through SMASE INSET for mathematics and science teachers in Kenya. The INSET was initiated due to the poor performance that had been witnessed in Mathematics and Sciences. The training focused on the change of teacher and learner attitude, and practice of learner-centered teaching. SMASE INSET has been in place in Kenya for over 20 years since its inception in the year 1998. With such length of time and the great resource investment towards the INSET, it would be expected that its impact is felt through increased and improved practice of learner-centered instructional methodologies (SMASSE, 2020). More learner-centered classroom environment results into better learner understanding instead of rote learning. Such an environment is a precursor for improved learner attainment. Therefore, there is need to interrogate whether the methodologies advocated for during the training eventually find their way in classroom practice. Such an investigation was to reveal the worthiness of the SMASE INSET and whether there is need for improvement. The present study therefore sought to investigate the classroom instructional activities exhibited by biology teachers who have undergone SMASE INSET training.

2. Literature Review

The current changing times requires an education that is palatable and responsive to learner and societal needs. The teaching methodologies and approaches to be used in schools and therefore classrooms need to be in response to this demand. In a study, Chitwa and Njuge (2004) found out that teaching and learning process had been predominantly teacher-centered and was aimed at examination; hence students were taught what works without understanding how it works. They observed that the lecture method was highly used leading to poor results in KCSE examinations. Poor results have continued to be witnessed in Biology national examination (KNEC, 2018; KNEC, 2020; Imanda, 2021). Teacher resource is one of the most important inputs into the education system (UNESCO, 2007; SMASE, 2020). In-service programmes should be regularly organized for teachers to improve their pedagogical skills (Republic of Kenya, 1991; Indoshi, 1999; Imanda, 2013; Imanda, 2021). Indoshi (1999) suggests a strong interrelation between in-service teacher training courses and classroom teaching activities. The studies described above are similar to the present study in that both studies look at the teaching methods used by in-serviced teachers. However, the present study differs from the studies described above with respect to the time the studies were carried out. These studies were carried out before the nationwide implementation of SMASE in Kenya. The present study focused the teaching methods used during biology teaching after SMASE

implementation. This revealed the extent to which biology teachers implement what SMASE training advocates for.

It has been observed that the Ministry of Education (MOE) should peg promotions and salary increments on SMASE attendance (Republic of Kenya, 2008; Imanda et al, 2014). The findings from a study by Mbaka (2009) in Kilifi District revealed that the low attendance of teachers to SMASE training was a hindrance to the effective implementation process. He found out that the highest attended SMASE cycle was the fourth cycle with 45% attendance by teachers. From his findings it is not clear whether these SMASE-trained teachers were implementing the methodologies taught during the INSET. This study is similar to the above in that both sought to find out the teacher attendance to SMASE training. However, the two studies differed since the present study further revealed the teaching methods used by SMASE-trained biology teachers.

Activity, Student-centered, Experiment, Improvisation (ASEI) is an approach by the SMASE INSET to turn the classroom environment from teacher-centered to student-centered (SMASSE, 2007; COMSTEDA, 2020). Students' higher order and critical thinking abilities develop when they are provided opportunities in practice and skills across diverse areas of curriculum. Bruner (1966) believes that the most effective way to learn is by discovering rather than being told by a teacher. ASEI has a constructivist's approach to teaching and learning (Serapion, 2018). This can be achieved through lessons having as many hands-on activities that allow for learner manipulation and participation. Improvisation of teaching and learning resources is also emphasized. The strength of ASEI movement is furthermore in the premise that meaningful learning only takes place in an environment in which students are actively engaged in focused and sequenced activities for acquisition of skills and knowledge (SMASE, 2020).

Similar findings were obtained by Waldron and Doherry (2010) who found out that students learn best if they are actively engaged and when their activities are closely linked to understanding important biological concepts. Kayapinar (2016) also recommends the use of appropriate model in INSET so as to create reflection of teacher self-efficacy in science teaching. Ameka and Nyakwara (2020) reveals that when learners are wholly involved in instruction, then learning is successful. In the studies described above the researcher focused on learner ability, school administration and teachers perception respectively. In the present study however the focus was on biology teachers adopting the survey research design in which no variable was manipulated. The design was the most appropriate since the independent variable (SMASE) lied outside the researchers' control and hence it was impossible and impractical to conduct an experiment.

While releasing the 2019 KCSE examination results, the cabinet secretary of education reiterated the poor performance in science subjects. Biology is one such science subject that was openly observed to have registered a dismal performance in KCSE examinations (KNEC, 2020; Imanda, 2021). In the 2017, 2018 and 2019 KCSE national examinations student performance in biology has consistently been dismal to the extent that a very small number of form four graduates were admitted into biological science-related courses in universities and tertiary institutions in Kenya (KNEC, 2020). A paltry 18% of the 2017 KCSE candidates managed to attain a mean grade of C+ or over in Biology (KNEC, 2018). Similar poor performance had previously been observed. In the year 2009 while releasing KCSE examination results, the then cabinet secretary of education observed that learners had dismally performed in sciences. He attributed this to inadequate staffing and lazy teachers who do not prepare for lessons. He adds, “We have issued firm instructions to all teachers to ensure they revert to using proper teaching instruments” (Siringi, 2010 p.5). Lesson planning is a very important process during classroom lesson preparation (COMSTEDA, 2020) however, there are no clear statistics by the MOE on the extent of lesson preparation by biology teachers leading to the poor performance in biology. The present study revealed the proportion of biology teachers involved in SMASE by considering the proportion of teachers who embrace lesson planning and preparation as reflected through their classroom interactive activities.

Serapion (2018) from a study on in-service training for teachers found out that INSET inculcates positive attitude among the instructors and the need for embracing instructional approaches that are learner friendly. The study revealed that INSET was constrained by serious shortage of teaching and learning materials, lack of programmes inclusiveness, limited time allocation compared to content, limited financial resources, poor record keeping and lack of commitment to some seminar participants. The present study unlike those described did not only focus on inquiry teaching but aimed to find out the other teaching methods used by SMASE- trained biology teachers when teaching students.

3. Methodology

The study adopted a descriptive survey research design. This design has an advantage of enabling collection of great wealth of data in a short period (O’Leary, 2017). Singh (2012) posit that this design is appropriate for educational fact finding studies by yielding a great deal of information which is accurate. These premise justified the choice of survey research design. The study was conducted in Emuhaya sub-county in Vihiga County in Kenya. Saturated sampling technique was used to select all the 33 SMASE-trained secondary school biology teachers in the sub-county. Saturated sampling technique is a non-probability sampling technique in which all the members of the target population are selected because they

are too few to make a sample out of them (O’Leary, 2017).

Data collection instruments included Biology Teachers Questionnaire (BTQ), Interview Schedule and Biology Teachers Observation Schedule (BTOS). The instruments were pilot-tested among teachers who later, did not take part in the main study. Three biology teachers took part in the pilot study. The BTQ were administered to four biology teachers. A pilot observation was conducted using the BTOS. After pilot-testing the instruments, appropriate adjustments were done to make them more valid. Validity and reliability of the instruments were further determined through piloting and test-retest respectively. A reliability coefficient of 0.94 was obtained which indicated that the BTQ was reliable enough to be used to collect data for the study. Validity was further attained by the instruments being examined by three experts in the Department of Educational Communication, Technology and Curriculum studies of Maseno University. The input of the experts aided in improvement of the face validity of the instruments.

The BTQ was personally administered by the researcher to the respective respondents in the sampled schools. They were collected back after two days. The short period ensured 100% response rate (Singh, 2012). The interview schedule was administered by the researcher to a sample of four biology teachers to follow up on their responses in the BTQ. A tape recorder was used to record the conversation that ensued during the interview session. The BTOS was organized and the date and time for the observation agreed on between the researcher and the respondents.

Data obtained in this study was analysed quantitatively using descriptive statistics. The tape-recorded data from the interview schedule was transcribed, compressed and categorized on the basis of the themes that were evident and those that emerged. The responses of learners in BTQ and the time captured from BTOS was calculated to arrive at percentages. These percentages revealed the proportion of time spent on content and that spend on process. The interview schedule aimed at providing information for follow-up on the responses in the BTQ which was analysed through content analysis. Pragmatic content analysis aided in arriving at the intended data from the interviewees’ verbatim. This data from the interview was to aid in validation and triangulation so that the data obtained is more valid. Tables and percentages were used to present the data.

4. Results and Discussion

The results and discussions have been presented on the basis of the two objectives that guided the study:

Objective 1: Teaching Methodologies used by SMASE-trained Biology Teachers

An instrument administered to the respondents to source for their opinion on the training methods used during

SMASE INSET. The biology teachers were asked to name the methods used during the SMASE INSET. Table 1 presents the instructional methodologies used by SMASE trainers during the training.

Table 1: Methods Used During the SMASE INSET

Teaching Method	Number of Teachers(n=33)	Percentage (%)
Lecture	30	90.90
Question and Answer	31	93.94
Discussion	33	100
Demonstration	31	93.94
Guided discovery	22	66.67
Inquiry	21	63.64
Practical	31	93.94
Field Trip	5	15.15
Project	8	24.24

From the data in Table 1, 90.90% of the biology teachers reported that the lecture method is used during the SMASE training. The lecture method is relatively faster in passing information and perhaps easy to organize but its effectiveness is questionable. On the use of question and answer teaching method, 93.94% of biology teachers in each case reported that the method is used during SMASE training. Of the sample population, 15.15% of biology teachers reported that field trips are used during the SMASE training. This was in agreement with the findings of Indoshi (1999) and Serapion, (2018) in which, the teachers under study preferred that the INSET trainers should use demonstration and field trips.

From these results, it is evident that, during the SMASE training, the lecture, question and answer, discussion, demonstration and practical methods are often used, guided discovery and inquiry methods are rarely used while, project and field trips are not used. In an interview session with the biology teachers, various responses were obtained on the same issue. The teachers were asked the common methods used by SMASE trainers. The methods that were identified by the teacher interviewees were lecture, question and answer and discussion. 80% of the

teachers interviewed said that the three methods were used during the SMASE training while 20% said that in addition to the above methods, practical method was also used. This concurs with the findings of Kayapinar, (2016) who stresses the relationship between teacher education and professional practices. She emphasizes that teachers are unlikely to learn how to use group work effectively by attending a lecture on group work where they are sitting silently listening to a lecturer teaching. Therefore the teaching methods used during the training are likely to relate to those used by the in-serviced teachers during their classroom teaching. The teachers further reported that, the evaluation method used by the trainers during the training were feedback evaluation sheets and question and answer techniques. The persistent and consistent use of traditional methodologies during teacher INSET limits the responsiveness learners to the current changes in the education sector which require an all-round learner. This limits learner engagement as suggested by the CBC.

The respondents were further asked the methods that they use during biology instruction in their various schools. Their responses are summarized in Table 2.

Table 2: Methods Used During the Biology Teaching

Teaching Method	Number of Teachers(n=33)	Percentage (%)
Lecture	28	84.85
Question and Answer	31	93.94
Discussion	32	96.97
Demonstration	32	96.97
Guided discovery	26	78.79
Inquiry	29	87.88
Practical	21	63.64
Field Trip	23	69.70
Project	16	48.49

The findings in Table 2 reveal that the highest proportion of teachers at 96.97% reported that they use discussion and demonstration methods. The method that received the least rating is project at 48.49%. A total of 84.85% of the biology teachers reported that the lecture method is used during their biology teaching respectively. On the use of question and answer teaching method, 93.94% of biology teachers reported that the method is used during biology teaching. Of the sample population, 69.7% of biology teachers reported that field trips are used during biology teaching. The classroom observation done however revealed that out of the nine biology lessons observed seven of them did not have activities that engaged learners hence were teacher-centered. This finding contrasts what teachers actually said. Therefore it is evident that lecture method was the dominant one in the classrooms. A study by Khadija (2009), revealed existence of such controversy whereby, teachers reported that they implement what they learnt in the INSET. However, the researcher was not able to actually observe this in class and therefore could not be sure it happens. With the above scenario, it may be inferred that what one says is not necessarily what he does. That is why triangulation was vital in this study so as to get the actual position in the classroom through observation schedule.

Scrutiny of the feedback evaluation sheets at the SMASE training centre was done. It was revealed that the evaluation sheets allow the biology teachers to evaluate the trainers twice a day; at the end of the morning session and the end of afternoon session. From the sheets it was evident that on a scale rating at four levels: very good, good, fair and poor, more than 50% of biology teachers rated the trainers at the level, good. This corroborates the responses from the questionnaires and interview schedule conducted.

Objective 2: Process versus Content Practice in Biology Classroom

BTOS was also used to observe biology teachers during their biology lessons. The instrument is divided in two sections: teacher talk and, talk and activity initiated and/or maintained by students. In part 1 of the teacher talk section, there are three sub-sections.

a) Teacher asks questions or invites comment

The SMASE-trained biology teachers were observed on various aspects under this sub-section. The observation revealed that content had 36 units of observed classroom transactions while process had 23. This represents 61.12% and 38.98% respectively.

b) Teacher makes statement

From the observation carried out on the SMASE-trained biology teachers, it was revealed that 23 units were observed on biology content representing 62.16% and 14 units on biology process representing 37.84%.

c) Teacher directs students on to sources of information

On this behavior, it was observed among the SMASE-trained biology teachers that, 15 units representing 60% was more of biology content while 10 units representing 40% was more of biology process.

In part two of the BTOS, where we had talk and activity initiated and/or maintained by Students, the observed transactions were as follows.

d) Students seek information or consult

The SMASE-trained biology teachers during the observation revealed 10 units representing 55.56% on content. On the other hand, eight units representing 44.44% showed process as predominating their biology lessons.

e) Students refer to teacher

In the classroom observation of SMASE-trained biology teachers, it came out clear that 11 units representing 52.38% portrayed content bias while 10 units representing 47.62% showed biology process.

From the above results obtained during a classroom observation of SMASE-trained biology teachers, it is evident that sub-sections (a), (b), (c) and (d) have a bias towards content hence such teachers can be rated as content-based. On the other hand, in (e) a balance between content and process was observed at 52.38% and 47.62%. Science teaching is expected to be more process based (Imanda, 2013) for increased understanding of science concepts. Bruner (1966) is of the view that the instructor should encourage students to discover principles by themselves. The instructor and the student should engage in active dialogue. The average student population of the classes observed were 43 students with the highest class having 68 students and the smallest class having 36 students. However, it is surprising that majority of the biology teachers in the sub-county present their lessons with a bias towards the content even after having attended several cycles of SMASE training. Despite the fact that from the questionnaires, the teachers reported use of learner-centered teaching methods, this was not congruent with what was observed during the classroom observation session. These findings concur with those obtained in a situational analysis by SMASE (2020) in which, most of the biology lessons observed were not involving experiments while only a few were involving experiments. Biology as a science is expected to involve experiments for increased understanding of the subject.

The content versus process dilemma comes down to teacher-centered versus learner-centered teaching methodologies. Process relates to hands-on while content relates to basic factual information (Sadhana, 2017). Process enables a learner to develop problem-solving skills, cooperation, respect and responsibility which are necessary for real life. It is regrettable that the teaching methodologies used by biology teachers in Emuhaya sub-county are still teacher-centered. Despite the enormous resources geared towards in-servicing biology teachers to apply ASEI and PDSI approaches, most of them are still

using teacher-centered methodologies. Such methodologies are far from learner engagement as CBC proposes too. Such methodologies limit learner participation and understanding. According to COMSTEDA (2020) and SMASE (2020) student-centered learning is a pedagogical paradigm shift that is currently attracting immense attention. Student-centered teaching does not necessarily imply a particular methodology of teaching. Nevertheless, certain methodologies may be better suited than others for student-centered classrooms. Frequent follow-ups after SMASE training are therefore necessary to ensure effective use of learner-centered methods advocated for by SMASE during biology teaching.

5. Conclusion and Recommendations

5.1 Conclusion

Over 20 years after SMASE inception, it is still revealed that biology classrooms are dominated by teacher-centered teaching methods. The teachers who teach in these classrooms have undergone several of the SMASE training cycles and modules. Despite the frequent training session in addition to the pre-service training, there was

minimum use of methodologies that engage the learner. Teachers' classroom interactions were furthermore biased towards biology content than process. Such methodologies therefore limit learner engagement hence understanding. In the long run it results in to low attainment whenever assessment and evaluation is done.

5.2 Recommendations

The study recommends that frequent follow-ups be done after the training to find out the extent of implementation the SMASE tenets. There is need for the education quality assurance and standards officers to follow-up regularly the teachers on the implementation of ASEI-PDSI approach, Lesson study, collaboration, among others in the biology classroom. However Biology teachers need to have a self-drive with an understanding that after attending a SMASE INSET, the teachings received are worth and need to be implemented for better and improved learner participation and attainment in biology. This will ensure Biology process-dominated classrooms. With the changing times the education provided requires to be delivered in a manner that is interactive and appealing so as to increase learner participation in the sector.

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