EVALUATION OF STRENGTHENING OF MATHEMATICS AND SCIENCE IN SECONDARY EDUCATION (SMASSE) PROGRAM IN BOTSWANA USING THE CIPP MODEL

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Abstract

Strengthening of Mathematics and Science in Secondary Education (SMASE) seeks to improve and enhance the quality of performance in teaching and learning of mathematics and science in secondary schools. The SMASE program started in Botswana 2006. This study aimed to evaluate the effectiveness of SMASSE program in Junior Secondary Schools of Botswana. A mixed method research design was used in this study. Data was gathered through interviews, lesson observations and a Self- report student questionnaire. The data was collected in three schools in Gaborone West cluster schools which were randomly selected. A total of 13 teachers and 113 students took part in this. Qualitative data were analyzed through thematic analysis approaches while quantitative data were analysed using SPSS software. The findings revealed that the SMASSE objective to train all mathematics and science teachers was achieved. The objective to ensure that teachers integrate ASEI/PDSI approach into the teaching and learning of mathematics and science was experiencing challenges mainly from lack of resources, teacher overload, large class sizes, student's negative attitude and lack of monitoring of the program. The findings also revealed that skills such as observing, hypothesis and concluding were often emphasized during teaching and learning. The findings also revealed that students have reported poor skills in science process skills. The findings revealed that teachers predominantly used chalk and talk method and discussion method as opposed to other students centered methods of teaching. In order to improve performance in mathematics and science, the Ministry of Basic Education, SMASSE team, Mathematics teachers and Science teachers should integrate ASEI/PDSI approaches in the teaching and learning of mathematics and science.

Key words: SMASE, PDSI, ASEI, CIPP, Evaluation, Integrate

Introduction

Over the years the desire to improve mathematics and science education has seen researchers develop many models and approaches to enable teachers to effectively deliver subject content to the learner. In spite of all the good methods and approaches available, it is evident that performance in mathematics and science has been very poor over the years. A study by The Trends In Mathematics and Science Study (TIMSS (2003) reveals that out of 46 participating countries, performance in mathematics and science in Botswana was below the international average. A number of factors that contributed to this poor performance could be categorized into 1) teacher factor, 2) Student factor and 3) teaching and learning resources and facilities. The issue is a serious one for teachers, parents, Ministry of Basic Education and other African countries. If this problem continues secondary school mathematics and science performance in Botswana will continue to fall below international average. In attempt to address poor performance in mathematics and science, Botswana benchmarked and adopted SMASSE (Strengthening of Mathematics and Science in Secondary Education) from Kenya.Strengthening of Mathematics and Science in Secondary Education (SMASSE) activities started in Kenya as a result of consistent poor performance in secondary school mathematics and science. In 1998-2003 Kenya and Japan jointly implemented SMASSE through in-service training for capacity building in mathematics and science education for teachers and education managers. In 2001, a network for mathematics and science involving 11 African countries and coordinated by SMASSE Kenya was formed to collaborate in addressing common challenges in mathematics and science education in member countries through INSET for effective pedagogy and classroom practices.

ASEI/PDSI Paradigm Shift

The SMASSE team came up with the Activity, Student, Experiment and Improvisation (ASEI) movement to upgrade the various aspects of teaching and learning. INSET activities aimed at a shift from knowledge, content based approach, few teacher demonstrations, theoretical or lecture method (chalk and talk) and teacher centered teaching to **A**ctivity focused teaching and learning, **and Student** focused/centered learning, **E**xperiment or research based approach, small scale and **I**mprovisation. (SMASSE project, 1998).

Objectives of SMASSE

The objective of the SMASSE program are to:

- Improve and sustain teaching and learning of mathematics and science in secondary schools.
- Integrate Activity Students involvement Experiment Improvisation (ASEI) and Plan Do See Improve (PDSI) approaches into teaching and learning of mathematics and science and enforce a shift from teacher centered to learner centered approaches.

- Train all mathematics and science teachers in ASEI and PDSI principles and practice.
- Provide support for ASEI/PDSI practices at school level.

The purpose of this evaluation is to determine the extent to which these objectives were met.

Evaluation Model

Evaluation models are mainly used as a base for making judgments of value or worth about the program. Evaluation models differ greatly with regard to evaluation approaches. As Erden (1995) states, researchers can choose the most appropriate model in terms of their purposes and conditions during their curriculum evaluation models or they can develop a new one making use of the existing ones. This study adopted the Context Input Process Product (CIPP) model which was developed by Stufflebeam (1971). This model considers evaluation to be a continuing process. Gredler (1996) suggests that this approach is based on two main assumptions. These assumptions are 1) that evaluations have an important role in stimulating and planning change and 2) that evaluation is an essential component of an institution's systematic program.

Conceptual Framework

A conceptual framework is used in research/evaluation to outline possible courses of action or to present a preferred approach to an idea or thought. It is further described as a linked set of agencies that assist in the critical analysis of a program. The evaluation framework derived from the CIPP is illustrated below.

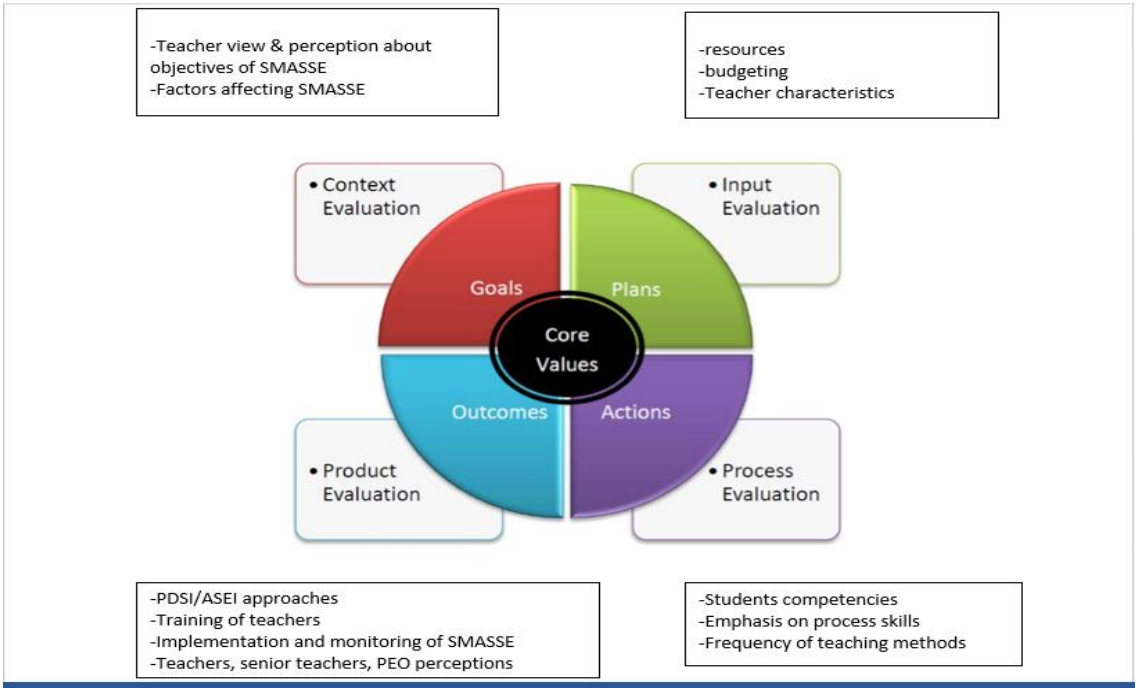

Figure 1. A conceptual frame work of the CIPP model

Purpose and Objectives of the Evaluation

The main purpose of this evaluation is to determine the effectiveness and outcomes of the SMASSE program in Junior Secondary Schools. It is also to establish if SMASSE program has improved and sustained the quality of teaching, learning and performance in science and mathematics.

Evaluation Questions

1. Context

a) What are the teachers view and perceptions about the needs and objectives of the program?

b) What are factors affecting the program?

2. Input

a) What resources are available for the implementation of the program?

b) What are teacher's characteristics, are they trained and qualified enough to implement the program?

3. Process

a) To what extend do teachers use PDSI/ASEI approaches in teaching and learning?

b) How is implementation and monitoring of ASEI/PDSI done?

c) What are the Teachers, Senior Teachers and PEO perceptions on the problems encountered in the implementation of the program?

4) Product?

a) What are the student's perceived competences in four science process skills namely observation, hypothesis, experimenting and conclusion?

b) What are the students overall perception of emphasis on science process skills?

c) What are student perceptions on the frequency of various teaching methods?

Significance of Study

It is hoped that the information gathered in this evaluation will sensitize Ministry of Basic Education and SMASE Committee to find various ways of improving classroom practices and achievement. The study will also contribute to the body of knowledge on how various factors affects academic performance of learners.

Methodology

Introduction

This section provides an overview of different evaluation approaches. It also provide information regarding evaluation studies conducted on SMASSE to improve the quality of student academic performance focusing on the approaches and methods in mathematics and science teaching,

Evaluation Approaches

Since the 1930s many evaluation approaches have emerged. According to Worthen et al (1997) evaluation approaches can be classified into the following: i) objective oriented approach, ii) management oriented approach, iii) consumer oriented, iv) expertise oriented, v) adversary oriented and vi) participant oriented approach.

Review of Studies That Has Evaluated SMASSE

Mwangi and Mugambi (2013) conducted a study in evaluation of SMASSE program in 2013 at South District Kenya. The study focused on discovering whether the SMASSE program was producing the intended or the desired goals.

The study adopted Kirkpatrick evaluation model. This model focuses on measuring four types of outcomes that resulted from a highly effective training program. The findings of the study revealed that the majority of teachers have not changed their attitude towards the SMASSE objectives. About 78.6% of teachers wished that INSET training could continue and 73.3% did not enjoy attending the INSET training. The results also showed that few teachers were willing to be observed by others.

Kamau, Wilson and Thinguri (2014) conducted a similar study on evaluation of the effectiveness of SMASSE program in performance of science and mathematics in primary school in Kenya. The purpose of the study was to evaluate effectiveness of SMASSE program in Kenya primary schools. The findings of the study revealed that training did not positively impact on performance in both mathematics and science. This was as a result of negative attitude of mathematics and science teachers toward training. The findings also showed that most teachers did not adopt ASEI/PDSI approaches leading to poor results in both mathematics and science.

A similar study was conducted by the Department of Educational Planning and Research Services in Botswana in 2010.The purpose of the evaluation was to assess the extent to which SMASSE program has improved and sustained the quality of teaching, learning and performance in mathematics and science in secondary Education in Botswana. The study revealed that performance in mathematics and science has dropped significantly over the years. The poor results suggest that there are other factors apart from teaching

methods that may affect performance. These factors included availability of teaching and learning resources, large class size and student's attitude.

Similarly, a baseline study was conducted in Botswana (1998) which aimed at identifying problem areas in chemistry: mole concept, electrochemistry, periodic table and organic chemistry. The study findings revealed that professional development programs for chemistry teachers can be beneficial in positively changing teacher's attitude towards teaching/learning, using various teaching strategies, work planning, ability to overcome teacher's limitations in teaching, and conducting various types of practical work in chemistry (SMASSE Project, 1998).

Evaluation Design

In this study a mixed method design was adopted. Tashakkori and Teddie (1998) defined mixed method as the combination of qualitative method and quantitative methods in research. The mixed methods enable the researcher to use different approaches to answer research question and therefore it was not limiting.

Sampling in Qualitative Approach

A purposive sampling was conducted with teachers. According to Patton (2002) in purposive sampling the researcher first identifies subgroups of the population of interest and then selects cases from each subgroup in a purposive manner. In this study the main focus was on a particular characteristic of a population that is of interest which are long service and teaching experience. The longest serving Maths and Science teachers with more time spent in a selected school were identified and sampled in this study. No sampling was done for senior teachers because each school has only one senior teacher, this is same with the PEO.

Qualitative Data Instruments

Qualitative data was gathered through interviews with teachers teaching Mathematics and Science in Gaborone West cluster schools. Written documents were also used to obtain more detailed information.

Interview

An interview schedule was used to provide information about 3 maths and science teachers, 3 senior teacher and 1 PEO's perception on the program implementation. Note taking was used during the interviews which were conducted individually. The interviews consisted of open ended questions related to the program as they gave the respondents the opportunity to express their points of views freely.

Lesson Observations

Lesson observations were done to provide information about teaching and learning in the classroom. A SMASE lesson observation check list was adopted. A total of 3 lessons were observed from the 3 selected schools. The main emphasis was about teaching

approaches and learner participation. This also provided information on how teachers design and implement ASEI/PDSI lesson plans. Availability of teaching resources, lesson introductions and lesson development were also captured by the check list.

Sampling in Quantitative Approach

A total of 3 Junior Secondary schools were randomly selected from 8 Gaborone West Clusters Schools to participate in this evaluation. One class was then randomly selected from each school to give a total of about 38 students from each school. The total population of this study was 121.

Quantitative Data Instruments

Self- report questionnaires was used for quantitative data. The questionnaire was designed with the purpose to find the students perceptions on mathematics and science process skills and perception on teaching methods.

Data Collection Procedure

Before conducting the study and to gain access to the sampled schools, a letter was written to the Ministry of Education, Skills and development, School Heads and Regional Directors which explained the details and purpose of the study. A schedule was also attached to the letters about the procedures to be followed during the data collection.

Qualitative Data Analysis

Qualitative data in this study came in various forms, this consisted of interviews, observations, document analysis and photographs. Qualitative data was analyzed by thematic data analysis approach. Attride-Striling (2001) defined thematic analysis as a flexible method that allows analysis of qualitative data that was collected through observations and interviews.

Quantitative Data Analysis

Quantitative data from student questionnaire was analyzed using SPSS software. Quantitative data analysis allowed the reporting of summary results in numerical terms. Cross tabulations and frequencies were also done to gain more specific information about variables among student. This included gender, age, educational background of parents, emphasis on proses skills, perceived competencies on skills and frequency of teaching methods.

Results

Introduction

This section reports and presents analysis and findings of the study. The data was analyzed and the results displayed using four parts of the CIPP model which are context,

input, process and product. Demographics of the total population was also displayed in this section.

Teacher's Demographic Information

The results in table 1 show distribution of 3 mathematics and 3 science teachers according to the teaching experience and gender. The table shows that most teachers had an experience of more than 10 years of teaching and none had 0-5 years of teaching.

Table 1. Mathematics and science teachers' demographic information

	Gender		**Teaching**	**experience**	
	f (males)	f (females	0-5	5-10	‹10
Maths	2	1	0	1	2
Science	1	2	0	0	3
Totals	3	3	0	1	5

Students Demographic Information

The table 2 shows that most students (55.8%) were 16 and above and only 44.2% were between 13-15 years. The Table also shows that the targeted population of this research graduated mostly from Tswana medium schools and only 21.8% graduated from English medium schools.

Table 2. Student's statistics

Type of primary school	f	%	Age	f	%
Tswana medium	89	78.8	13-15	50	44.2
English medium	24	21.2	16 & above	63	55.8
Totals	113	100		113	100

Context

Two questions guided this section

- What are the teacher's perceptions and views about their needs and objectives of the SMASSE program?
- What are factors affecting the SMASSE program?

Training

The results from teacher interview indicate that all teachers of maths and science in all the 3 selected schools were invited for training workshops through letters. The School Heads released teachers for training. The trainings were done during the school vacation at teacher training centers and teachers were pleased with this training.

Roles and Contributions

The results from teacher interview revealed that most maths and science teachers showed understanding of their roles and expected contributions towards the SMASSE program. Teachers were well informed about the objectives of SMASSE. Training manuals were available for them.

SMASSE Objectives

All the 2 science teachers indicated that the program failed to achieve some of its objectives because of a number of challenges and factors. These included among others shortage of resources, students' indiscipline and attitudes, long syllabus and large class size. Maths teachers also reported that the program is not effective due shortage of textbooks, calculators, mathematical sets and grid boards

Input

Statistical data was analyzed using SPSS

- The first question was on teacher characteristics, how many teachers were trained and how many were not trained. This also included the number of school management team (SMT) trained and not trained for SMASSE. The SMT included HODs, School Heads and Deputy School Heads.

The results on table 3 show that 100% of mathematics teachers were trained and 11 out of 12 science teachers (91.67) were trained for SMASE. On average the results show that 95.87% in total of all mathematics and science teachers in all the 3 schools were trained for SMASSE. The results also show that all the School heads (100%) were trained for SMASSE. None of the Deputy and HODs were trained for SMASSE.

Table 3. Frequency of trained and untrained teachers

subject	**f trained**	**f not trained**	**total**	**% trained**
Science	11	1	12	91.67
Mathematics	12	O	12	100
SMT	7	6	13	54
Total	**30**	**7**	**37**	**81.89**

- The second questions was whether the resources were adequate for implementation of the program and what were the factors affecting the implementation of the program.

Data from three mathematics and three science teachers' interviews was analyzed separately. A thematic data analysis approach was used. Themes that emerged from the data were laboratory conditions, class size, teaching loads, syllabus coverage, students' attitudes and lack of resources. Photographs were used to corroborate interview data.

Laboratory Conditions

All science teachers interviewed complained about the use of science laboratories as class base rooms. In all the three schools visited all the science laboratories were used as base rooms and science teachers were not comfortable with this scenario.

Figure 2. Science laboratory used as a class base room

Some teachers in one school complained about expired chemicals in their store rooms. The teachers said that they decided to lockup one store room because expired chemicals have not been collected for some times and this was a health hazard for both teachers and students. Some teachers complained about itchy rush that was developing in their skin after coming into contact with expired chemicals.

Figure 3. Some of the expired chemicals in science laboratories

Class size and Teaching Loads

According to both maths and science teacher interviews, class size ranged between 40-46 students per class. Teachers felt that their class size were very large and implementing SMASSE was difficult. This made it difficult for teachers to plan and reach out to all learners. Teachers indicated that students in large classes had limited opportunities for interactions and participation in learning activities. One teacher further indicated that dividing students into effective group seem to be very difficult with large number of students. Figure 4 shows student crowded in the science laboratory.

Figure 4. Students crowded in the science laboratory

Syllabus Coverage

Maths and science teachers complained about the long syllabus and that they were unable to finish the syllabus by the end of the year. SMASSE approach is more concerned in students mastering concepts than syllabus coverage. This however was difficult for teachers because the school management expect teachers to finish the syllabus well on time so that students can have enough time to revise for their final examinations while SMASSE emphasizes mastery of concepts than syllabus coverage.

Process

This part is guided by the following questions

- To what extent do teachers use PDSI/ASEI in teaching and learning?
- How is in-service training of teachers done?
- How is the implementation and monitoring of the program done and what are the problems encountered?

Lesson Planning

It was observed from class observations that most teachers in both maths and science had SMASSE lesson plan booklets. The observation revealed that all of maths and science teachers were finding it difficult to plan for SMASSE lessons. Some of the reasons were that they have too many classes to plan for every lesson. SMASSE encourages teachers to plan and consider students background such as learning difficulties, misconceptions and interests.

Development of the Lesson

Lesson development was unsatisfactory. There was no hands on activities in most lessons observed. Only science teachers tried to perform demonstrations in class but the materials were inadequate. Most of the time teachers used the chalk and talk method. The lessons were not encouraging at all. SMASSE emphasis active participation of students and that was not the case. Skills such as observing, measuring, concluding were not facilitated in most of the lesson observed. In general this section of PDSI was poorly executed.

Classroom Supervision

According to SMASSE teachers are to supervise classwork, attend to student's needs and ability. Teachers are also expected to keep an eye and monitor student's feelings and invite questions from students. Student's supervision was excellent especially during group work. This was even better in mathematics lessons. Students asked lots of questions to show understanding especially in problem solving questions. Science supervision was however bit difficult because of large number of students surrounding the table. There were about 5 tables

in each science lab. An average of 9 students sat around the table. This made supervision and participation difficult for teachers.

Teacher Self-Evaluation

The lesson plan booklets also showed that most teacher do not conduct a self-evaluation as it is shown in figure 6 below. Teachers were also expected to submit lesson plans to HOD and Deputy School Head for checking and signing. This was not done in most lesson plans. Teachers did not give reasons why they failed to self-evaluate and why they failed to submit lesson plans to their supervisors.

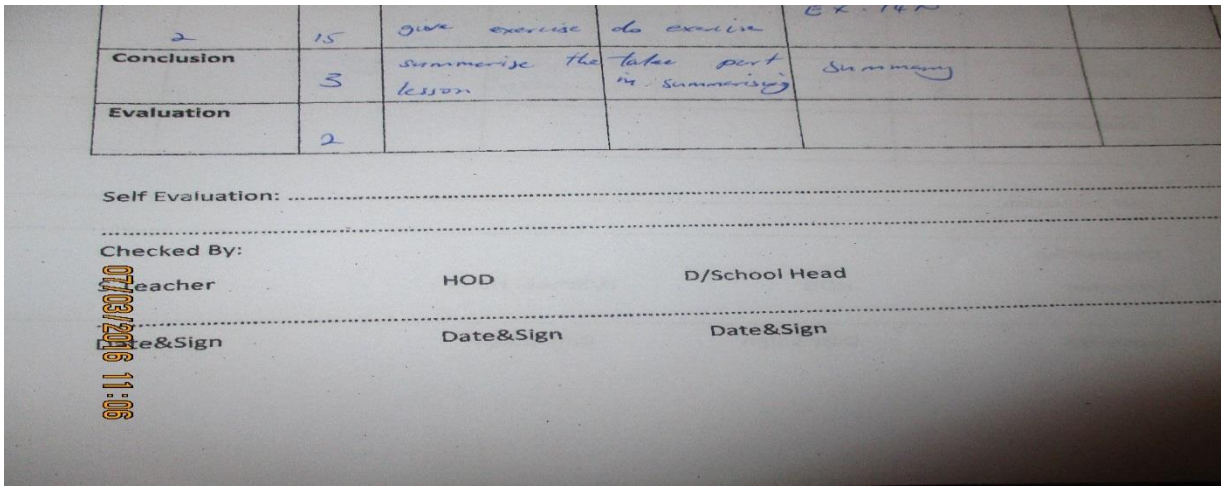

Figure 5. A non-evaluated lesson plan

Experiment

None of the lessons observed involved a practical or experiment. However there were some instances especially in science lessons where the teacher demonstrated. According to SMASSE practical work or experiment help students to solve related problems, make deductions from practical work and verify hypothesis and predictions. This was lacking in, most of the lessons observed. The observations also corroborate the teacher perception on the implementation of the SMASSE program.

Improvisation

In this section SMASSE advocates for utilization of locally available materials especially from students immediate environment. This according to SMASSE enhances participation and students are able to use improvised materials. This element of improvisation was only observed in one science lesson observed. The teacher asked students to bring learning materials from their homes e.g. fruits and seeds.

The PEO Interview

The PEO revealed that their roles is to train teachers, hold workshops and visit schools to support, mentor and determine progress made by SMASSE program. He further revealed that SMASSE team held workshops in all regions in Botswana to train teachers on SMASSE since 2006 to date. He indicated that large number of teachers received training and that those who have not received training were resourced at school level by the trained teachers. The PEO indicated that SMASSE team is expected to carryout 3 visits to each school per year to check progress and monitoring. He revealed that this has indeed failed due to lack of funds and transport. He also mentioned that the ministry has rolled out SMASSE program in colleges of education to prepare graduates and new teacher for the program. He further revealed that senior teachers observe and offer support to junior teachers on the implementation of PDSI/ASEI lessons. The PEO gave the following as challenges especially on training, implementation and monitoring of the program: Lack of transport in some regions, lack of resources, failure to carry out school visits, lack of program evaluation, failure to compile progress reports on SMASSE and high staff turnover.

Product

This part is guided by the following questions

- What are the students overall perception on emphasis on science process skills?
- What are the student's perceived competencies in four science process skills?
- What are the student's perception on the frequency of various teaching methods?

The first section of the questionnaire was to find the overall perception of students on teacher emphasis on various process skills during lessons. Table 4 reports the frequency and percentages of students' perception on emphasis on science process skills during lessons. More than one third (37%) of the students reported that observation, hypothesis and conclusion skills were often and always emphasized during teaching and learning. The results reveals that less than 32% of students reported that experiments were rarely and never emphasized throughout the lessons.

Table 4. Students overall perception on teacher emphasis on science process skills

	Students responses					
Emphasis on process skills	Never	Rarely	Sometimes	Often	Always	Total
Observation	9 (8.0%)	9 (8.0%)	51	16	26	113 (100%)

			(45.1%)	(14.2%)	(23.0%)	
Hypothesis	15	20(17.7%)	33	21 (18.6)	24	113 (100%)
	(13.3%)		(29.2%)		(21.2%)	
Experiment	12	25	54	15	7.0 (6.2%)	113 (100%)
	(10.6%)	(22.1%)	(47.8%)	(13.3%)		
Conclusion	11 (9.7%)	8 (7.1%)	37	20	39	113 (100%)
			(32.7%)	(17.7%)	(34.5%)	

Figure 6 reports students' perceptions on their competencies on various science process skills. As it is from the figure 6 an average of 45% of students rated their competencies as poor and satisfactory in observing, concluding, experimenting and hypothesizing skills. However more than 38% of the students rated themselves as good in observing, hypothesizing and concluding. A smaller percentage (less than 11%) of students rated themselves as excellent across all the process skills.

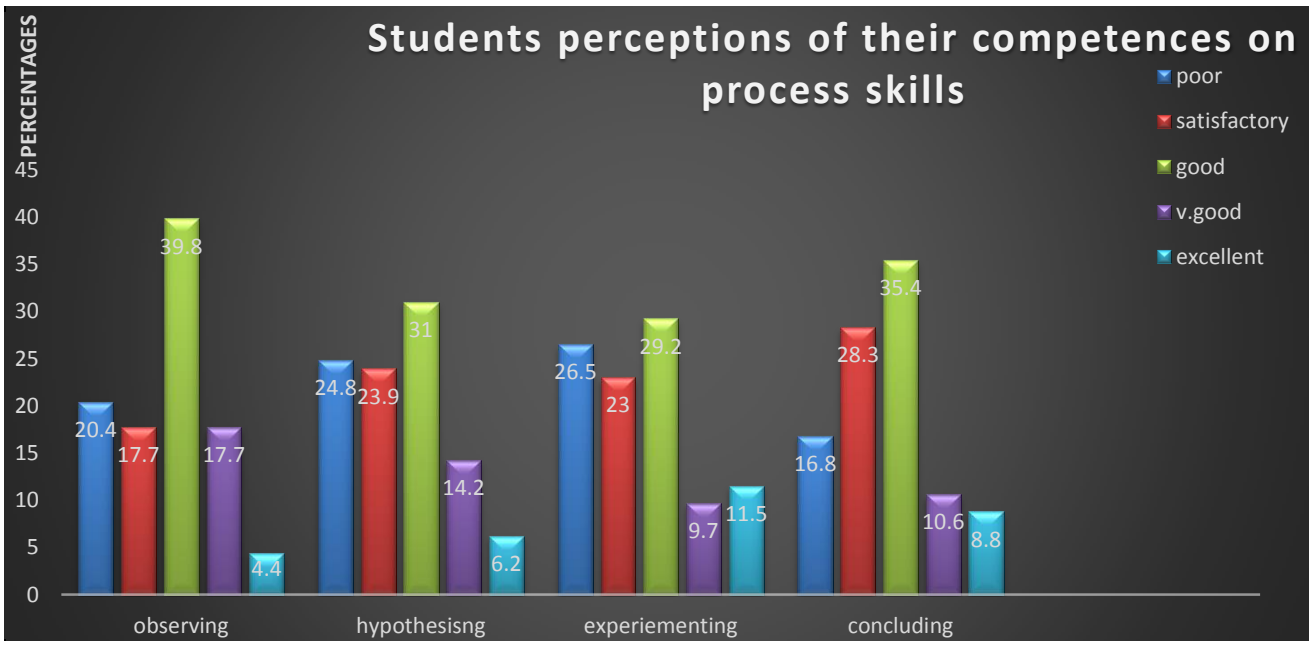

Figure 6. Competencies of students in science process skills

The other section of the questionnaire required students to provide data about the frequency of various teaching methods in their lessons. Figure 7 shows the percentages for

students' perceptions on various teaching methods during their lessons. The results shows that more than 60% of students reported that the role play method and group work method were never or rarely used during their lessons while more than 70% of students reported that chalk and talk method and discussion method were often and always used during their lesson.

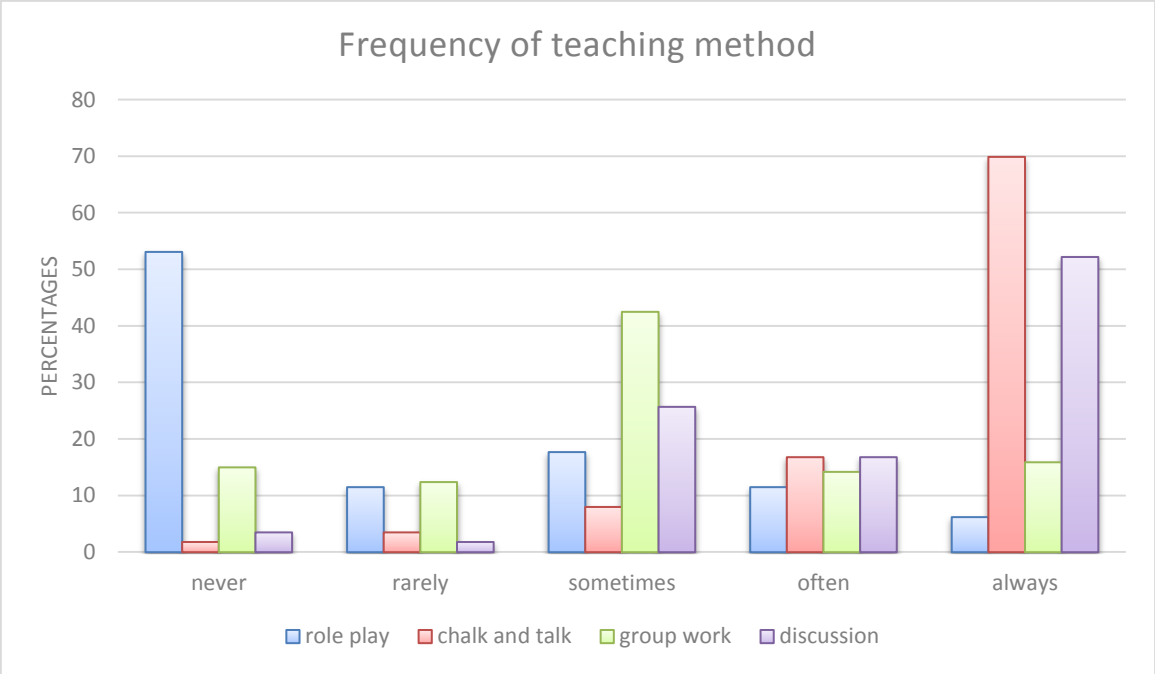

Figure 7. Frequency of various teaching methods

Discussion

Data about the context was gathered through individual interviews with mathematics and science teachers. The results considered mainly the perceptions and views about the needs and objectives of the program. The findings also revealed how consultation process was done regarding training of teachers. The results indicated that all teachers were trained for the program. Some were consulted through workshop training and some were consulted at their colleges of education. The results indicated that teachers were invited through letters routed through their school heads. All teachers showed understanding of their roles and contributions expected from them on the implementation of the program. According to Carol-Ann Morgan (2013), consultation can recognize opportunities, help to make sure ideas work effectively and assist in decision making. It also identifies and track needs and expectations.

The results also revealed that some objectives of SMASSE have been achieved and others have not been achieved. The SMASSE objective to train all mathematics and science teachers has been achieved. Objective such as Integrating ASEI/PDSI in teaching and learning and teacher training has not been achieved.

Results from qualitative data forms (Tables 1and 3) indicate teacher statistics on training. The results show that 95.83% teachers were trained for SMASSE both for

Mathematics and Science. All School Heads and senior teachers were trained. The results indicate that none of the Deputy School head and Head of Departments were trained. One of the major objectives of SMASSE is to train all mathematics and science teachers including School Heads, Deputy School Heads and Head of Departments. This is to ensure that the program runs smoothly in their schools and this forms implementation and monitoring of the program.

According to SMASSE all mathematics and science are to be trained for SMASSE together with senior teachers using a direct mode. The results indicated that was successfully done. According to SMASSE there was no plan to train school heads, deputy and HODs, however the need arose after the roll out of the program as a results of implantation and monitoring at school level. Subsequently, a two- day workshop was held for SMT to sensitize them on the program.

With regard to resources, data from individual interviews, indicated that resources were not adequate for implementation of the program in all the three schools. Science teachers did not have apparatus to carryout experiments and class activities. Teachers indicated that the program could not run without adequate teaching and learning resources. Katui (2005) stated that students are able to see and feel what the teacher is teaching if there are teaching and learning resources. Lee (2006) revealed that most of the low performing schools have limited resources. Teaching and learning resources form and integral part in teaching and learning of mathematics and Large class sizes makes it difficult for teachers to plan and reach out to all learners. According to Kratt (1994) students' achievement and performance can be negatively affected by class size of more than 40. According to the objective of SMASSE the class size and teaching load should be reduced to at least 20 students for proper implementation of the program. Mosteller (1999) indicated class size as a determinant of academic performance. Several studies have shown that smaller class size perform even better academically than large class size.

Teachers complained about the long syllabus and that they were unable to finish it by the end of the year. SMASSE approach is more concerned in students mastering concepts than syllabus coverage. This however was difficult for teachers since the school management expect teachers to finish the syllabus well on time so that students can have enough time to revise for their final examinations while SMASSE emphasizes mastery of concepts than syllabus coverage. This, according to teachers, brought conflict between school management and science teachers. Teachers revealed that they had weekends teaching as well as afternoon teaching to cover the syllabus on time.

The results gathered through observation schedules indicated that teachers do not use PDSI/ASEI in teaching and learning. 100% of teachers do not plan and deliver lessons according to ASEI/PDSI lesson planning. According to SMASSE teachers should do the following:

Teachers should plan their lessons by preparing lesson plans. Planning involves how the lesson unfolds, stating the rational of the lesson and taking into consideration the students' background. According to SMASSE (2010) planning a lesson entails how the lesson unfolds, taking into consideration how students understand individual concepts and connect them to their real life situation.

The results from to lesson observations indicated that student were not involved in their lessons and hence no lesson activities and practical work. This was due to lack of planning, shortage of labs and shortage of lab apparatus and equipment. The most common activity in all the class observation was group work and teacher demonstrations. SMASSE advocates for practical work to be done in lessons and appropriate task given to students. The general aims of practical activities are to enable learners or students to visualize and understand mathematical and scientific concepts, also to develop some process skills (SMASSE 2010). These process skills enhance creativity, logical thinking and reasoning. In this aspect of student involvement SMASSE encourages student's centeredness. Students should be encouraged to give their prior experiences, hypothesis, ideas and observations. Students did not do activities on their own but the teacher was demonstrating most of the time.

The results from the interview with PEO regarding implementation and monitoring indicated that monitoring and implementation have failed due to lack of funds, transport and other logistics. According to SMASSE objectives the SMASSE team has to make 3 visits to each school every year to check progress and monitoring but this has failed.

The results from the data collected through student's questionnaire indicated that teachers emphasize certain process skills over other skills. The results in table 4 reports and reveals the frequency and percentages of students' perception on emphasis on science process skills during lessons. More than one third (37%) of the students reported that observation, hypothesis and conclusion skills were often and always emphasized during teaching and learning. The results reveals that less than 32% of students reported that experiments were rarely and never emphasized throughout the lessons. One of the objectives of SMASSE is to equip students with science process skills. These skills include observing, hypothesizing, experimenting and concluding. According to SMASSE these skills must be emphasized during teaching and learning of mathematics and science. The SMASSE training manual (2009) shows that the quality of the lesson activities should facilitate the growth of science process skills.

The study also revealed students competencies in science process skills. Figure 6 reports students' perceptions on their competencies on various science process skills. As it is from the figure 7, about 45% of students rated their competencies as poor and satisfactory in observing, concluding, experimenting and hypothesizing skills. However more than 38% of the students rated themselves as good in observing, hypothesizing and concluding. A smaller percentage (less than 11%) of students rated themselves as excellent across all the process skills. In order to increase the competencies of science process skills, a more communicative and interactive approach could be implemented during teaching and learning of mathematics

and science. Students needs a lot of hands on activities to address this problem of less competencies in science process skills. Numes (1999) argued that to enhance competencies of scientific thinking skills, teachers should emphasis science process skills and provide direct interactions with students during teaching and learning. More experiments and practical activities could be done in order to help students get more competent in science process skills. Thus it can be concluded that the SMASSE program lacked sufficient focus on science process skills.

Figure 7 show the percentages for students' perceptions on various teaching methods during their lessons. The results as shown in the figure 7 shows that more than 60% of students reported that the role play method and group work method were never or rarely used during their lessons while more than 70% of students reported that chalk and talk method and discussion method were often and always used during their lesson. One of the objectives of SMASSE is to shift from teacher centered approach to students centered learning approach and from chalk and talk method to experiments and research based approach. Jeffry et al (2003) states that students centered approach in teaching mathematics and science assume only if students/learners are participating actively and that's when they can learn deeply and enjoyably.

Conclusion

The SMASSE objective to train all mathematics and science teachers has been achieved. SMASSE objective to ensure that teachers integrate ASEI/PDSI approach into the teaching and learning of mathematics and science is experiencing challenges and cannot be said to have been achieved. This failure to achieve the objective results mainly from lack of resources, teacher overload, large class sizes, and lack of monitoring of the program by Regional Education Officers, Program Coordinators and School Management Teams. Students' perceptions of the science process skills reveals that SMASSE is not achieving its objectives of improving mathematics and science through ASEI/PDSI approach. Students have reported poor skills in all the science process skills namely observing, hypotheses, experimenting, and concluding. The teachers predominantly use chalk and talk method and discussion method as opposed to other students centered methods of teaching.

Recommendations

Based on the discussions and results of this study, the following recommendations may contribute to the improvement of the program.

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- Students should be given more practical work and experiments in order to build their competencies in science process skills.
- SMASSE team, Mathematics teachers and Science teachers should make sure ASEI/PDSI approaches are well integrated in teaching and learning of mathematics and science.

- The department of Secondary Education should make sure hire laboratory technicians in schools to help science teachers...
- The Government of Botswana should build more classrooms in schools to address the issue of science laboratory as base room.
- The Government of Botswana should also hire more mathematics and science teachers to reduce teaching loads and address the issue of large class size.
- The department of Secondary Education should ensure proper disposal of expired chemicals from the laboratories.
- The Ministry of Basic Education must ensure there is a proper budget for SMASSE program.

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