TEACHERS' CONCERNS WHEN IMPLEMENTING INNOVATIONS: STRENGTHENING SECONDARY SCIENCE EDUCATION IN KENYA

Dr Caroline Waruguru Ndirangu[1]

Dr Grace Nyagah[2]

ABSTRACT

Change facilitators often presume that once an innovation has been adopted and the intial training has been completed, the intended users will put it into practice. However, implementation of an innovation is seldom simple without support. In 1998, Kenya adopted the Strengthening of Mathematics and Sciences in Secondary Education (SMASSE) in-service training programme, using a constructivist methodology to improve Science performance. The emphasis was on 'activity-focused methods, student-centred activities, experimenting and improvisation' (ASEI) through the 'plan, do, see, and improve' (PDSI) approach. The objective of this study was to establish the level of implementation of the ASEI/PDSI classroom practices innovation and the stages of concern of the implementers. The study also sought to establish how the teachers' concerns affect the implementation of the ASEI/PDSI classroom innovation. Concerns in innovations range from self, to task, and finally to impact levels. The survey design was used for a sample of 68 head teachers, 147 Science teachers and 10 trainers. The main instrument for the study was the Stages of Concern Questionnaire (SoCQ). The study established that the majority (75%) of the teachers, were partial implementers of the ASEI/PDSI innovation, and only 5% were full implementers. The majority of the teachers had concerns regarding self that affected the level of implementation and innovation; few had task and impact concerns. The study recommended that appropriate support be given to these teachers by the head teachers and Ministry of Education officials. This is likely to lead to interventions that will hopefully resolve their individual concerns and hence raise the level of implementation of the innovation.

Key words: implementation, teachers' concerns, in-servicing, science education, innovation

1 Email: cawandi57@gmail.com

2 Department of Educational Administration and Planning, University of Nairobi, Kenya
Email: nyaga_grace@uonbi.ac.ke

INTRODUCTION

When organisations adopt innovations they do so with high expectations, anticipating an improvement in organisational productivity and performance (Klein, Conn & Sorra, 2001). One of the major innovations in Kenya's education system is the Strengthening of Mathematics and Sciences in Secondary Education (SMASSE) in-service training (INSET) programme, which started in 1998. It was an intervention in response to the declining quality of teaching and learning in Mathematics and Science education. The SMASSE intervention strategy was a pedagogical shift, and the phrase *activity-focused, student-centred, experimenting and improvisation (ASEI) through plan, do, see and improve (PDSI) approach* (SMASSE, 2008) was coined. The emphasis is on learner-centred pedagogy.

Despite the ASEI/PDSI classroom practice intervention, there was minimal change in students' performance in the sciences. The first cohort of teachers trained between 2003 and 2007 had been in the field for 10 years by the time of this study. Yet the Kenya National Examination Council (KNEC) results still indicated that the majority (over 60%) of the marks scored by the students at the end of national secondary school examinations were between D and D minus (KNEC, 2012).

The SMASSE Project was launched in 1998 as a pilot project in nine districts and expanded to the national level in July 2003. The INSET unit was then located at the Kenya Science Teachers College (KSTC). The project is under the care of the Directorate of Quality Control and Assuarance. The SMASSE project has had three main donors: the Japan International Co-operation Agency (JICA); the Ministry of Education (MOE); and the District Education Boards (DEBs), through levies provided by parents. JICA provided training of Kenyan counterparts in Japan, provided long-term and short-term experts for the programme, and supplied equipment and materials to the national and district level in-service training component.

The Ministry of Education provided salaries, travel, subsistence allowances and accommodation for national trainers. It also provided building to house the national and district level in service training. The District Education Boards gave allowances to the service trainers at district level (SMASSE, 2008. The District SMASSE in-service training cluster management also established resource centres where teachers could access information; obtain assistance; and use computer facilities, materials and various resources for teaching.

The Centre for Mathematics, Science and Education in Africa (CEMASTEA) acted as the national centre for in-service training for Mathematics and Science teachers. This was in order to improve their pedagogy and hence the performance in these critical subjects (SMASSE, 2008).

Science instruction has widely embraced support for 'hands-on', student-centred, inquiry-oriented programmes and constructivist classrooms (Brooks & Brooks, 1993). The constructivist approach to teaching and learning lays emphasis on critical thinking and problem-solving skills in students, by means of which they plan for, direct and create their own learning. Such a classroom demands a different role for the teacher. Brown and Adams (2001: 424) describe the changing nature of the teacher in constructivist learning environments: 'Teachers must shift their attention away from themselves as effective presenters of scientific information, towards a focus on student's developmental needs to learn science with understanding.'

One of the key objectives of the study was to determine the levels of concern of the science teachers during the implementation of ASEI/PDSI classroom practices. The study also sought to establish how the teachers' concerns affected the implementation of the ASEI/PDSI classroom innovation. ASEI/PDSI is a learner-centred teaching methodology in the sciences, which, if implemented effectively, should significantly improve the learners' performance in the Kenya Certificate of Secondary Education (KCSE) in Biology, Chemistry, and Physics. Ndirangu's 2006 study on the evaluation of SMASSE in-service training found that the implementation of ASEI/PDSI classroom practices had shortcomings and therefore the benefits of the innovation had not trickled down to the beneficiaries, namely the learners.

Concerns of implementers during implementation of innovations

Among the earliest research on teachers' concerns regarding the implementation of changes was carried out by the psychologist Fuller (1969), which presented a more clinical rather than a pedagogical point of view. The study established that the concerns of the teachers corresponded to their career stages: pre-teaching, the early teaching phase, and the late teaching phase. In the pre-teaching phase, the newly qualified teachers with no teaching experience seemed to exist in a place of unconcern. In the early teaching phase, the beginners expressed concerns about their ability to deal with class control and their preparedness to handle the content. In the late teaching phase, the senior teachers' concerns were about the pupils' learning.

As the body of concerns documentation grew, researchers hypothesised that there were definite categories of concerns among innovation adopters. Researchers have identified seven 'Stages of Concern' (SoC) about an innovation, through which individuals progress as they implement an innovation (Hall, Hord, George & Stiegelbauer, 2006). These have been summarised in Table 1.

Table 1: The stages of concern during the implementation of an innovation

Common effect	Stage	Name of stage	General characteristics of stage
Impact	6	Refocusing	The individual focuses on exploring ways to reap more universal benefits from the information, including the possibility of making major changes to it or replacing it.
Impact	5	Collaboration	The individual focuses on co-coordinating and co-operating with others regarding use of the innovation.
Impact	4	Consequence	The individual focuses on the innovations' impact on students in his or her immediate sphere of influence. Considerations include the relevance of the innovation for students, the evaluation of student outcomes, and the changes needed to improve the student outcome.
Task	3	Management	The individual focuses on the processes and tasks of using the innovation and the best use of information and resources. Issues relating to efficiency, organisation, management, and scheduling dominate.
Self	2	Personal	The individual is uncertain about the demands of the innovation, his or her adequacy to meet the demands, and his or her role within the innovation. The individual analyses his or her relationship with the reward structure of the organisation.
Self	1	Informational	The individual indicates a general awareness of the innovation and interest in learning more details about it. Any interest is impersonal.
Self	0	(Awareness) Unconcerned	The individual indicates little concern about or involvement with the innovation.

Source: Adapted from Hall, Hord, George & Stiegelbauer (2006: 8)

Teachers' concerns, identified through the profile interpretation method of analysis, are demonstrated in seven stages, which can be categorised into three major groups. These are: self-concerns stage at the lowest level, task concerns at the intermediate stage, and the final impact stage. The **self-concerns** stage includes unconcerned (0), informational (1), and personal (2). The **task concerns** stage

is management (3) and the **impact concerns** stage includes consequence (4), collaboration (5), and refocusing (6).

METHODOLOGY

Before establishing the level of concerns of the teachers, the study first established the extent to which ASEI/PDSI practices were implemented by the teachers. This was done using teachers' self-assessment and head teachers' assessment of the teachers' use of the ASEI/PDSI approach. .

The study used a survey design methodology. It adopted purposive, stratified random and simple random sampling procedures. To carry out the sampling process for the target population, the schools were categorised as high-performing, medium- and low-performing schools, with regard to the Kenya Certificate of Secondary Education national examinations mean Science scores. Stratified sampling based on this criterion identified 68 schools, whose head teachers participated in the study.

Purposive sampling of 147 teachers was carried out, targeting those who had attended the SMASSE in-service training. Simple random sampling was applied to select 16 key informants, namely the SMASSE Science district trainers. The data was collected using a published instrument, the Stages of Concern Questionnnaire (SoCQ), which comprised 35 Likert-scale questions. The questionnaire had a high internal reliability of 0.76 and therefore was appropriate for the study (Hord et al., 2006). The data was analysed using the Stages of Concern Profile Interpretation Analysis, which is one of the most frequently used methods of interpreting data from the SoCQ.

Further, to determine the level of implementation, the Science teachers were asked to indicate how they used the ASEI/PDSI classroom practice. The responses were categorised as: fully = 3, partially = 2, and not at all = 1. The same question was put to the head teachers in order to verify the teachers' level of implementation of ASEI/PDSI classroom practices. The categories used for the head teachers to assess the teachers were as follows: fully = 3, partially = 2, not at all =1, and undecided = 0. The results are presented in Table 2 below.

Table 2: Level of implementation of ASEI/PDSI by Science teachers

Assessment	Fully %	Partially %	Not at all %	Undecided %
Teachers	15	75	10	n/a
Head teachers	24	62	3	11

As can be seen in Table 2, self-assessment by the teachers indicated that only 15% of the teachers implemented the ASEI/PDSI classroom practices fully, while the majority of the teachers (75%) implemented it partially. These teachers implemented certain aspects selectively, hence partial use of the innovation. When the teachers were asked what they mainly implemented, the majority indicated aspects of improvisation with practical materials during 'some' of the practical lessons. They also used their newly acquired knowledge of difficult techniques in their subjects. One of the teachers who was observed during a Biology lesson was applying a technique (acquired during a SMASSE in-service training session) for a genetics lesson in Form 3, namely squashing of plant chromosomes in an onion root tip, with great success. Though the teacher had not prepared the ASEI lesson plan, the teacher had prepared a practical manual as required and the lesson that was observed was learner-centred.

With regard to the head teachers' assessment of the extent to which teachers implemented the ASEI/PDSI, the results indicated that 62% of the teachers implemented ASEI/PDSI classroom practices partially, 24% fully, and 3% did not implement at all. From Table 2, it is noteworthy that the head teachers were undecided regarding the use of ASEI/PDSI in 11% of cases. The results indicate that there is a slight difference between the head teachers' assessment and the teachers' self-assessment. However, the general consensus was that the implementation of the ASEI/PDSI classroom practices by the Science teachers was mainly partial. It was therefore important to establish why the teachers were not implementing the ASEI/PDSI innovation fully in their classrooms.

Teachers' stages of concern during implementation of ASEI/PDSI Classroom practices

The profile interpretation method of analysis groups teachers' concerns in seven stages. Each of the seven stages is represented by a percentile score. The higher the score, the more the individual is concerned about a particular stage.

The strength of the Stages of Concern Questionnaire, other than revealing concerns, is in determining how individuals make use of innovations. Inexperienced users will have high concerns at the informational and personal stages; experienced users will have high concerns at the consequences and collaborative stages; while non-users' concerns will be high in the early stages and low in the later stages. Figure 1 represents the summarised results of the stages of concern for all the Science teachers involved in this study.

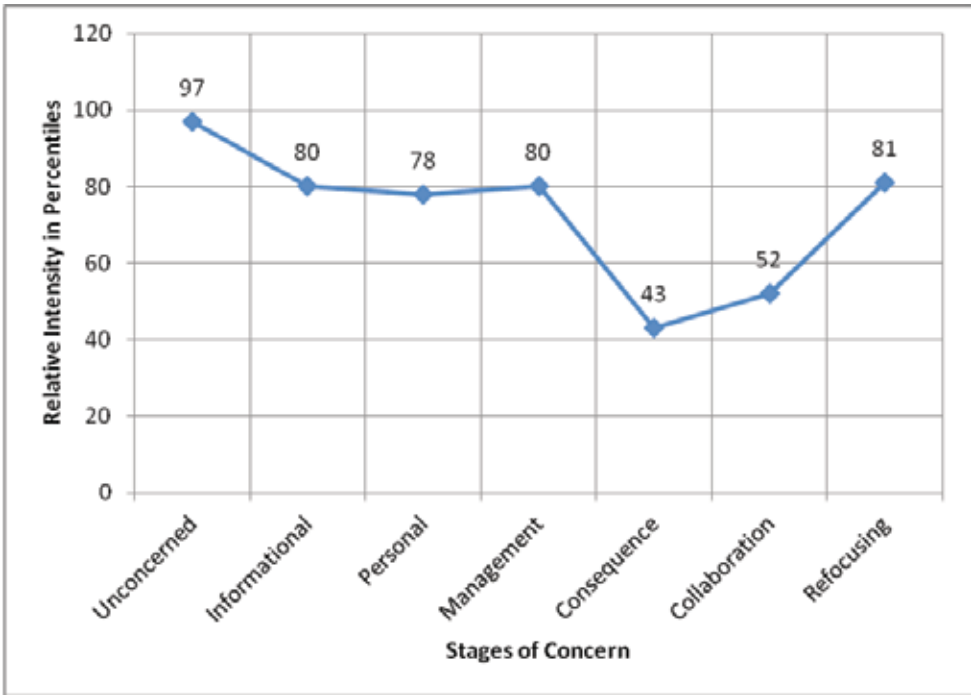

Figure 1: Summary of Stages of Concern Profile for all Science teachers in the study (N=147 teachers)

Figure 1 presents a summary of the stages of concern for all the Science teachers in the group. The data indicates that the highest percentile score is at stage 0 (unconcerned) while the second highest concerns are at stage 6 (refocusing). The percentile scores at informational (1), personal (2) and management (3) are also high.

The increase in concern at stages 5 and 6 of the Science teachers' profile provides additional information about the possible attitude of the teachers towards the ASEI/PDSI innovation. Moving up to the 81st percentile from the 52nd percentile is quite significant. This phenomenon is also a warning that the respondents might be resistant to the ASEI/PDSI innovation. This increase is drastic and should therefore be heeded as a warning when addressing resistance to the innovation.

Individual teachers' profiles in stages of concern

The following section presents individual profiles of stages of concern for teachers in Biology, Chemistry and Physics, operating at different levels of adoption of the ASEI/PDSI innovation. Below is an example of a Chemistry teacher's profile. This specific teacher is a partial user of the innovation.

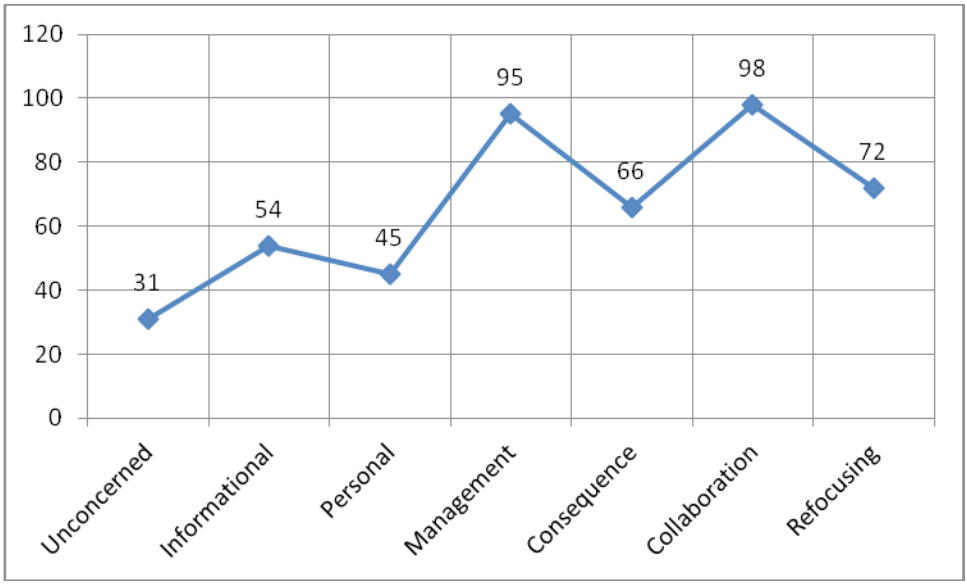

Figure 2: Stages of Concern Profile for a Biology teacher: partial user of ASEI/PDSI innovation

Figure 2 indicates that the Biology teacher had low concerns in the self-category, that is, stages 0, 1 and 2; and high concerns in the task stage (4) and impact stages (5 and 6). This implies the respondent is a partial or inexperienced user of the ASEI/PDSI classroom methods. The respondent's highest percentile score is at stage 5 (collaborative) followed by a high score at stage 3 (management), indicating that the respondent is a partial user who still has task concerns and yet also has impact concerns regarding the ASEI/PDSI innovation.

Below is a profile of a chemistry teacher who is a user of the ASEI/PDSI innovation.

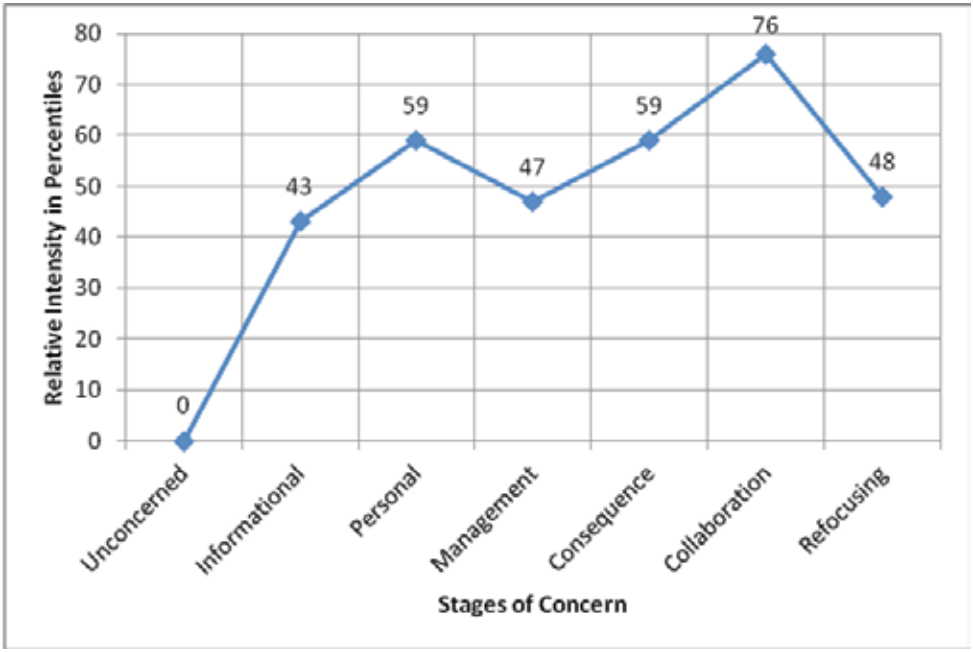

Figure 3: Stages of Concern Profile for a Chemistry teacher: user of ASEI/PDSI innovation

Figure 3 indicates the respondent is a holistic user of the ASEI/PDSI classroom practices. The respondent's profile peaks at stage 5 (collaboration) implying that the teacher is interested in working with colleagues and others in co-coordinating the use of the ASEI/PDSI innovation. However, the teacher still has management concerns. This respondent, a team leader at a training centre, spent much time

co-coordinating the SMASSE INSET activities throughout the year. The respondent explained that the centre remained open throughout the year for the teachers undergoing the SMASSE in-service training to borrow materials, and seek clarification on issues pertaining to the programme. This particular centre served 40 schools. The respondent reported that the majority of the teachers were implementing the ASEI/PDSI classroom practices partially, and there were some who did not use the innovation at all.

Figure 4 depicts the profile of a non-user of the innovation.

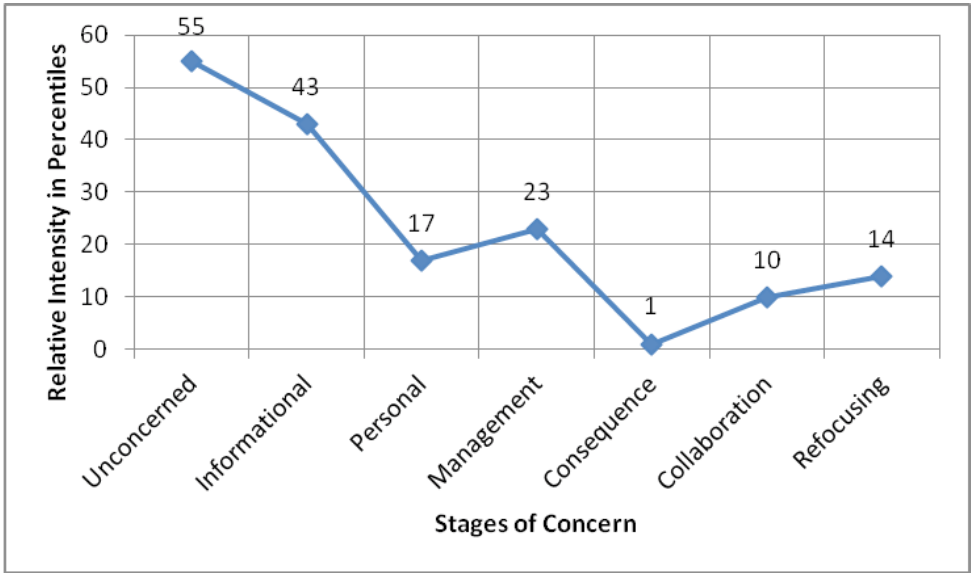

Figure 4: Stages of Concern Profile for a Chemistry teacher: non-user of the ASEI/PDSI innovation

Figure 4 indicates that the Chemistry teacher's scores are highest at stages 0 (unconcerned) and stage 1 (informational), and lowest on stage 4 (consequences). This implies the respondent is a non-user of the innovation. The respondent's self -assessment confirmed that the teacher did not use the ASEI/PDSI innovation at all.

The profile of a Physics teacher who implemented ASEI/PDSI classroom practices fully and for an extended period is shown in Figure 5.

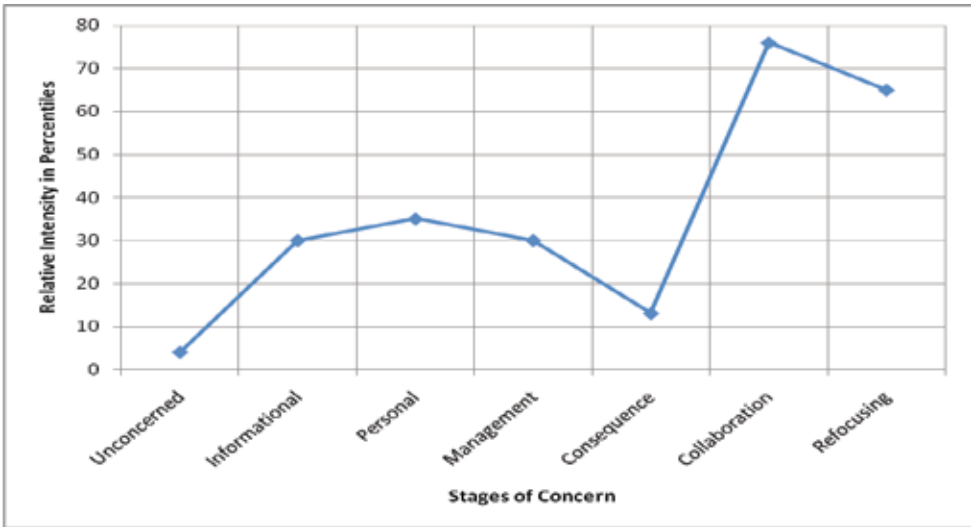

Figure 5: Stages of Concern Profile for a Physics Teacher: experienced user of the ASEI/PDSI innovation

The Physics teacher's profile indicates low percentile scores in the self-category of concerns, as well as in the third or management stage. However, the teacher had high percentile scores in stages 4, 5 and 6, which suggests that the respondent was an experienced user and was concerned about the impact of the ASEI/PDSI innovation. The highest percentile score at stage 5 implies the respondent's intense concerns were about collaborating with others in the use of the innovation. According to Hall et al. (2006), such a respondent is likely to be an administrator, co-coordinator or a team leader. The demographic data confirmed that the respondent was both a SMASSE District Trainer and a Dean of Studies and therefore co-coordinating others was a priority, as indicated by the high score at stage 5 (collaboration).

As mentioned earlier, the overall teachers' Stages of Concern Questionnaire group profile data indicate that the majority of the teachers in question were partial users of the innovation. This was further confirmed by their self-assessment, wherein the majority of the teachers indicated that they implemented ASEI/PDSI classroom practices only partially. This corresponded to the profile of inexperienced users in this study. However, among them were users with varied concerns about the implementation of ASEI/PDSI classroom practices. Concerns can be a highly

effective guideline for actions that facilitators might take in the implementation of change. According to Hord et al. (2006), the first step is to identify the intense concerns that individuals have, and the second step is to deliver interventions that might ease these concerns.

The change facilitators, such as the head teachers and the district trainers, should enhance the visibility of others who are excited about the innovation. In an interview carried out with some of the trainers, it was noted that many teachers were not enthusiastic about the training. They reported that most of the teachers made an appearance but did not participate in the activities organised by the trainers during the in-service training. One of them cited incidents such as '…trainees arriving at the venue but staying in the bus until time to go back to their homes at the end of the day for those who were commuters'. Others 'took very long breaks or refused to come back to the activities after a break or waited to sign in at the beginning of the sessions then left the premises soon after signing in' (Interview: SMASSE District Trainer).

Results suggest that this group of teachers may not have the necessary information about the innovation because they did not fully participate during the training. This is reflected by the high stage 2 scores (informational) of the Science teachers' profile shown in Figure 1, which indicates personal concerns were high (78%).

Respondents gave suggestions geared towards improvement in implementing the ASEI/PDSI innovation. For instance, one of the teachers had this to say: 'Fellow teachers should be counseled on the importance of their change of attitude towards implementation of ASEI/PDSI classroom practices.' When asked to indicate an opinion as to how the implementation of the ASEI/PDSI classroom practices could be improved, one respondent indicated, '...by all teachers practicing it from the heart rather than appearing to do it for the sake of doing it'. Some respondents further indicated: 'Teachers must change their negative attitude towards SMASSE in-service training.'

The study also revealed that the majority of the Science teachers in question had heavy teaching loads and other responsibilities. Many of them were also handling large classes. The teachers therefore indicated that they had little time left to prepare the ASEI/PDSI lesson plans. Comments such as the one below showed that the teachers felt the strain of overloaded timetables. One respondent noted that: 'It is not possible to apply ASEI/PDSI as the teacher will only be assessed in

terms of how many students pass, not how well they have understood the scientific concepts.'

Another respondent suggested that 'drilling was a better option', compared to pursuing the ASEI/PDSI approach. This opinion cannot compete with the constructivist methodology of learning, which the ASEI/PDSI approach has adopted for the teaching and learning of sciences.

Management concerns of the teachers were also high at 80%.The facilitators need to clarify specific 'how to' issues that often cause management concerns. On the other hand, many implementers indicated that they needed help in sequencing the activities and setting timelines for their accomplishments. Many of the teachers indicated that if they planned according to the ASEI/PDSI requirements, they would never complete the syllabus. Some mentioned that their heavy teaching loads did not leave them with time to prepare ASEI lesson plans, which are time consuming.

Consequence concerns for the majority of the teachers was the lowest score at 43%. There is a need therefore to understand why the teachers were not concerned with the impact of ASEI/PDSI on the performance of their learners. The low score could also be attributed to the teachers' focus on the role of the students, and of the administration, rather than on the process of being able to achieve good learning outcomes. For instance, one teacher commented: 'Students should be more positive about Science and the school should avail more resources to enhance use of practical lessons and improvisation.'

Collaboration concerns of the teachers were at 52%. The District SMASSE in-service training organises meetings with teachers from 40 different schools, where they can learn together and establish a network for future collaboration. The District SMASSE in-service training cluster management has also established resource centres where teachers can access various resources for teaching. This study revealed that the teachers were not making adequate use of this forum to establish networks. All four resource centres visited were under-utilised. The rooms were dusty and one of the facilitators lamented that the chemicals were expired because the majority of the teachers did not make use of the resource centre.

Refocusing concerns, stage 6, had the second highest teachers' score at 81%. This implies that the teachers had other ideas about the ASEI/PDSI innovation, whether positive or otherwise. The facilitators of change, such as the head teachers

and trainers, ought to encourage the teachers who may have better strategies for dealing with the innovation, to voice them freely. These individuals should be encouraged to channel their ideas and energies in ways that would be productive.

According to studies conducted by George, Hall, and Stiegelbauer (2006: 41-42):

> The tailing up and tailing down of the respondents curve at Stage 6 gives additional information about the attitude of the respondent toward the innovation.... When the respondents curve tails down at Stage 6, the respondent does not have ideas that would potentially compete with the innovation. When Stage 6 concerns tail up, one can infer that, the respondent has ideas that he or she sees as having merit rather than the proposed innovation.

The findings of the study indicated that 49% of the individuals in stage 6 showed tailing up while 51% showed tailing down at this refocusing stage. The tailing up, for most of the teachers, is more than 7%: the range needed to detect the overall concerns of the individuals as they implement an innovation (Hall, Dirksen & George, 2006).

The tailing up of the teachers who are non-users in this study, is a warning that the respondents might be resistant to the ASEI/PDSI innovation. This tailing up is considered severe and should therefore be heeded as a warning: resistance to the innovation should be addressed. The teachers seem to be resisting the use of the ASEI/PDSI classroom practice. Supporting data indicated that at least 30% of the teachers had negative attitudes towards the use of the ASEI/PDSI classroom practices.

RECOMMENDATIONS

The study makes the following recommendations:

- The management of the SMASSE in-service training programme at the national level, and the Quality Assurance and Standard Officers of the Ministry of Education in Kenya, should address the root cause of the teachers' concerns. Most of the concerns were traced to the in-service training phase. There is therefore a need to assess the training strategies of the trainers.
- The government should employ more teachers to reduce the student-to-teacher ratios and consequently reduce the teaching load. This will give teachers ample

time to prepare for ASEI/PDSI lessons. This will also facilitate students being put in manageable groups to apply the learner-centred approaches that the innovation recommends.

- There is a need for facilitators of change, both at the training and the implementation stages, to legitimise the existence of the implementers' concerns and allow the expression of their personal concerns. The facilitators should also establish whether the programme's expectations are attainable when they recommend the ASEI/PDSI innovation.

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