

INFLUENCE OF TEACHER SELF-EFFICACY ON TRANSFER OF STRENGTHENING OF MATHEMATICS AND SCIENCE IN SECONDARY EDUCATION (SMASSE) PEDAGOGICAL SKILLS IN KENYA

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ABSTRACT

Teachers form a pivotal pillar in curriculum implementation. The pedagogy employed by the tutors to achieve effective teaching and learning has been of great concern to actors of education since time immemorial. Studies have shown that governments worldwide dispense with huge financial and human resources to attempt to discharge professional development with a view to impart relevant pedagogical skills meant to have a more competent teaching force. Such has been the case for SMASSE training for science teachers in several African countries (Kenya included) but not much is known about the contribution of teacher self-efficacy in enhancing application of Activity, Student-oriented Experiments and Improvisation (ASEI) using Plan Do See and Improve (PDSI) approach which is a modern pedagogy in science instruction. The purpose of this study was therefore to investigate the influence of teacher self-efficacy in the transfer of SMASSE pedagogical skills in secondary schools in Kenya.

The study was delimited to Kisii County and adopted ex post facto research design. A sample of 230 science teachers, 87 principals, and 750 forms four students comprised the informants. Data were collected by the use of questionnaires, lesson observation, and document analysis. Descriptive and inferential statistics were used to analyze data. Hypotheses were tested using the Pearson product moment correlation coefficient at a level of significance $p < 0.05$. The study found teacher self-efficacy to be moderate. The null hypotheses relating to the association between teacher self-efficacy and transfer of ASEI-PDSI pedagogy was not rejected implying that teacher self-efficacy did not influence the use of this pedagogy in Kenya. This research recommended that principals should henceforth work towards enriching their tutors with self-efficacy through harnessing the four sources of teacher efficacy namely; Mastery experience, vicarious experiences, verbal persuasion, and psychological and affective states.

KEYWORDS: *Self-Efficacy, Pedagogical Skills, Transfer, Sciences, Practical Activities, Performance*

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INTRODUCTION

Science curriculum implementation which is devoid of experiments is an activity that is half done (Kidman, 2012). This explains why science courses worldwide urge science educators to engage students in learning experiences

which are full of practical activities as a way of stimulating effective learning. According to Faize and Dahar (2011), schools across Europe and America embolden teachers to employ active students' involvement in lesson activities so as to develop science process abilities which are considered as critical 21st-century skills. Despite the noble purpose that learner-centered pedagogy is meant to serve, most science teachers in developing countries have resolved either by design or through intuition to ignore practical activities and instead have settled for traditional teaching strategies (Asokhia, 2009). As expected, the science teachers who have stuck with the status *quo*, do give a spectrum of reasons ranging from lack of time to inadequate science equipment to justify their standpoint. Investigations done in Nigeria and South Africa by Asokhia(2009) indicate that science tutors do not involve learners in practical activities. Several studies were done in Kenya (cemastea 2011; smasse inset, 2010; smasse, 1999; Ndirangu, 2013 and Aminata, 2015) have equally reached the conclusion that there is a pedagogy crisis in science instruction in Kenya today. This is because the use of the much-demonized lecture method still dominates classroom discourse across this country. This scenario still manifests itself despite great efforts made by the Japanese International Cooperation Agency (JICA) and the Government of Kenya to encourage the use of student-based activities (the ASEI-PDSI pedagogy). A study was done in South Africa (Muwanga-Zake, 2001) determined that science teachers complained of laboratory safety and shortage of science equipment as the major impediments to effective implementation of the science curriculum. A survey by the same researcher established that there were many apparatus, chemicals and biology specimen which were gathering dust in laboratory shelves yet the teachers complained of deficiencies as the reason for non-performance of science experiments by students. In the same line, CEMASTEIA (2016) reports that school principals attested the fact that many science teachers lacked the capacity to prepare experiments.

Like in South Africa and elsewhere in the developing world, the Government of Kenya through the Ministry of Education dispenses with huge financial resources to procure science equipment for use in public secondary schools (the Republic of Kenya, 2015). The issue of laboratory safety as a challenge to the performance of experiments brings to the fore a serious concern in the teaching of science subjects. It should not be lost on observers that the concept of laboratory users' safety is well covered in both pre-service teacher education and in in-service courses like SMASSE INSET. To this end, it is probably teacher beliefs about their ability and confidence (Self-efficacy) to engage the science instructional media that is the problem. It was therefore against this background that this research set out to investigate the influence of teacher self-efficacy in the transfer of SMASSE pedagogical skill in Kenya.

Statement of the Problem

Training of science teachers in Kenya by Centre for Mathematics Science and Technology Education in Africa (cemastea) was launched countrywide in the year 2003 to equip them with ASEI-PDSI pedagogical skills to use to improve the hitherto poor performance in the sciences in Kenya Certificate of Secondary Education (KCSE). However, Science performance by percentage before and after the advent of the training has remained appalling (between 41 and 16). The argument generated by this scenario is that SMASSE training of science teachers in Kenya has not achieved the objective for which it was commissioned. Indeed, the Kenya Government through the Ministry of Education has used a multi-faceted approach aimed at turning around the issue of despicable performance in the sciences. Chief among these Government's strategies is the provision of professional development of science teachers on the use of a modern pedagogy that revolves around practical activities which make the learning process enjoyable and meaningful. In spite of this effort, operationalization of practical activities in science curriculum implementation in Kenya has remained elusive. The current study was, therefore, an attempt to establish the role of teacher self -efficacy on the utilization of ASEI-PDSI pedagogy in

science teaching in Kenya.

Significance of the Study

The findings of the study were anticipated to have both theoretical and practical implication for the future of SMASSE pedagogy in curriculum delivery in Kenya and the rest of Africa where this professional development initiative was underway. In theory, the research was expected to contribute to the advancement of knowledge on teacher self-efficacy as a variable which informed the effectiveness of the use of ASEI-PDSI pedagogy by science teachers in Kenya. In a practical sense, the study was to provide school managers, more so principals, with an understanding of how they would develop and nurture self-efficacy in science teachers so as to ensure sustained engagement of ASEI-PDSI instructional approach.

Limitations of the Study

Examination malpractices were given as the first possible limitation of the study as it was identified as a threat to internal validity to the dependent variable (KCSE performance). Secondly, the hypothesis used in drawing inference only showed a correlation between the independent variable and the dependent variable and not causation. As a remedy to the consequences of the limitation on examinations cheating, the researcher avoided schools which had a history of cheating in KCSE. Random sampling was employed to counter the second limitation on the hypothesis vis-a-vis correlation between dependent and independent variable.

Delimitations of the Study

Although the study was entitled “influence of teacher self-efficacy in the transfer of SMASSE pedagogy in a secondary school in Kenya,” a geographical delimitation was imposed to narrow the locale to Kisii County. As at the time of the study Kisii County had 9 sub-counties, 319 public secondary schools, and 1420 science (biology and chemistry) teachers. It should also be noted that only biology and chemistry teachers participated in the study leaving out those of physics and mathematics. The necessity of this was to cut down on logistical requirements to enable the process of data collection to take place. Secondly, the study used mean percentage scores as the dependent variable and not individual student’s percentage scores. Again, this was geared to simplify the process of data analysis by way of reducing the time resource utilized.

Assumptions of the Study

- It was assumed in the study that:
- CEMASTEAM conducted high-quality training for science teachers. Effective use of ASEI-PDSI pedagogy would automatically translate to improvement in performance in biology and chemistry.
- Respondent cooperated and gave honest and accurate data and
- the researcher was objective when carrying out lesson observations.

LITERATURE REVIEW

Teacher self-efficacy is a concept that dates back to Albert Bandura’s social cognitive theory which scholars of behavioral sciences have come to consider to be its base. In its simplest conceptualization, the term self-efficacy refers to an individual’s judgement of one’s capability to perform given tasks. It then follows that teacher self-efficacy in relation to

pedagogy implies a teacher's beliefs about the ability to execute the function of curriculum delivery. As applied to this research, teacher self-efficacy denotes a science teacher's personal judgement of one's capability to plan and present lessons as per the ASEI-PDSI requirement. In line with the preceding definition of teacher self-efficacy, Ashton (1986) argues that effective learning in the classroom will occur when teachers are convinced that they are indeed equal to the task before them.

Many researchers (notably Henson, 2001; Schunk, 2012 and Guskey, 1994) have done extensive study on the construct of teacher self-efficacy and have reached the conclusion that:

- Teachers of sound levels of self-efficacy more often than not put the welfare of their learners first.
- The concept of teacher-efficacy is a critical determinant of quality curriculum implementation.
- High self-efficacy in educators enables them to face difficulty situations like lack of adequate instructional media when teaching. Such teachers will tend to use improvisation to overcome such challenges.
- Efficacious tutors are slow to surrender when faced with problems associated with the handling of students and relating with school administration.
- Higher teacher confidence (efficacy) has been found in teachers who readily take up roles and perform their duties without much supervision.

Education International Research Institute (2012) commissioned an international survey on behalf of the University of Cambridge faculty of education. The overall purpose of the study was to collect data, the analysis of which would be used by the institute to develop and put forward policy recommendation to be used to enhance teacher confidence and self-efficacy among other concerns. The United Kingdom, Greece, USA, Macedonia, Bulgaria, Turkey, and Egypt are the countries whose teachers participated in the study. The survey tool of the investigation asked teachers to write what they thought would enhance their self-efficacy and self-confidence beliefs so that they could make a positive difference to the well-being and learning of children. In response, the teachers gave an array of factors which they felt impinged on their ability to do their job. These ranged from decent wage, respect from the mass media for the teaching profession, positive parental involvement in schools, lack of respect from the ministers of education and interference by the political class to non-involvement of teachers in policy formulation. Others were non-valuing of teachers' opinion on education issues by their governments and failure to have stable policies which would last for some time. This study concluded that the way the teaching fraternity was being handled by those in power was inimical to the development and nurturing of teacher self-efficacy.

Coladarci (1992) and Greene (1988) have studied teacher efficacy and report that it has critical consequences with regard to teacher behaviors that shape learners' performance as well as students' cognition such as outcome projections and appraisal. Tutors with higher self-efficacy have been found to embrace formal pedagogical innovations and staff development programmes more readily than their peers with lower self-efficacy (Guskey, 1987). Teacher self-efficacy has also been associated with parental participation in school events where research evidence (Hoover-Dempsey, 1987) established that tutor efficacy, totalled at the institutional level, had the greatest influence of the five areas where parents' role is involved. Perhaps more consistent with this is the finding that more efficacious colleagues are less likely to regard teacher-parent relations as a source of stress (Parkay, 1986).

A research carried out in the United States of America by Coladarci (1992) aimed to examine the degree to which school factors and teacher self-efficacy influenced teacher commitment to teaching. A sample of 170 teachers was used to respond to a questionnaire containing the teacher efficacy scales borrowed from Gibson and Dembo (1984) instrument. Data were analyzed using simple correlation and regression. The central finding of this study was that teacher self-efficacy was the strongest predictor of teacher commitment to pedagogical innovations like ASEI-PDSI instructional method.

Studies by Yang and Huang (2006) have come up with a theory on the construct of teacher sense of efficacy that borrows heavily from Albert Bandura's work. In this theoretical framework, beliefs of educators concerning individual ability as professionals in the teaching career greatly influence their productivity. Like earlier researchers before them, Yang et al. (2006) state in this theory that instructors with higher self-esteem are ahead in terms of management of learners under their care. Such educators are also bestowed with abilities to device ways used to tackle new challenges that confront them when engaged in their professional calling.

More recently, Ereno and Nunez (2014) investigated teacher self-efficacy and teacher commitment in the Philippines. Their concern was to find out how these constructs (self-efficacy and commitment) relate with each other and which of the two concepts make a teacher a better tutor. A sample of eighty lecturers was used to volunteer the required data. The research instruments were used to collect information on commitment and teachers' sense of efficacy. All the data collection instruments had reliability of above 0.87. The outcome of this investigation confirmed the hypothesis that sense of efficacy is statistically significantly associated with teachers' dedication to their schools. Tutors who were dedicated to their workplace also perceived that their classroom management was superb, believed they had better instructional strategies and perceived that they could improve learners' performance in and outside school. Like earlier studies (Coladarci, 1992), the outcome of the foregoing study indicated that the degree of teacher sense of efficacy was directly related to their students' achievement.

It is a truism that teacher quality defines learners' rating in curriculum evaluation. According to WoolFolk-Hoy (2000) teacher confidence has been found to shape motives of learners, tutors readiness to accept new teaching methods like ASEI-PDSI pedagogy, how to manage their classrooms and their decisions to participate in capacity development programmes like SMASSE training. Although the perception of teachers' efficacy is known to predict targets intended to be achieved and their dispositions towards curriculum change, tutors having sound efficacy have higher chances of applying knowledge in Nobel situations. This argument thinly refers to the requirement that science teachers need to be creative so as to improvise to surmount the problem of shortage of science equipment in schools.

Documented works on teacher self-efficacy seem to be in agreement about the association between this concept and realization of educational objectives. Rose (as cited by Adu, 2012) investigated how tutors' efficacy relates to the work environment. The result of this study established that educators of high self-efficacy collaborated more with their colleagues in their departments and exhibited more collegiality than less efficacious teachers. More confident teachers were also found to be more active in shaping actions taken by school leaders to enhance a more effective school context. On the other hand, lower self-esteem among teachers was associated with tutors who were not permitted to take part in policy-making on formative evaluation and upward mobility by teachers at the school level.

Following a concerted effort by education researchers to understand the role of teacher-efficacy in science education, there is a catalogue of evidence on this subject. It has emerged that there is a positive influence placed on teachers' way of teaching by teacher- efficacy. Further studies by Tschannen-Moran (2009) have shown that tutors of low

self-esteem discourage learners and also do less to motivate students to put extra effort into their academic work. However, teachers of high efficacy have been found to go an extra mile in terms of remedial teaching and attending to learners personal issues. All these go a long way in boosting learner scores in science examinations (Allinder, 1994). The input of Gibson and Dembo (1984) and Caprana and Barbanelli (2006) shows that they concur with the foregoing sentiments and add that more confident teachers welcome pedagogical innovations like SMASSE pedagogical skill into their day to day professional practice.

Aurah and McConnell (2014) approached the study of teacher efficacy differently from scholars who preceded them. Their study compared the efficacy of American teachers with their Kenyan counterparts using a cross-sectional research design. In conclusion, it was determined that teachers in the United States of America had higher confidence in embracing curriculum innovation than their Kenyan peers. Another key finding of this study was that female teachers in Kenya were found to possess lower efficacy than their Kenyan males. A contrary observation with regard to gender was made in American teachers. This outcome demonstrates the role that context or culture can have on the concept of teacher efficacy and teachers' orientation towards topical issues.

The attention of many education scholars has been attracted to the topic of the role of teacher-efficacy on the ability of teachers to effectively take charge of proper delivery of the science curriculum in Kenya. The situation of this nature has been accelerated by the nose-diving trend of science scores in national examinations that have from time to time raised eyebrows among stakeholders of education in the country. It is in order to point out that being educators, science tutors are automatically at the center of science curriculum implementation; for this reason, their feelings about the existing state of affairs and their capacity to reverse the situation cannot be understated. Consequently, it's the teachers' personal judgement about their ability to transform approach to the teaching of the sciences and subsequent improvement in performance that matters most. In particular, the teachers' confidence to employ ASEI-PDSI as the most preferred pedagogy seems to be the panacea of the moment (CEMASTE, 2016). As those in charge of capacity building of teachers in Kenya (and the rest of Africa) have consistently argued, there is arguent need now more than ever before for science teachers to embrace this 21st-century pedagogy (Waititu and Orado (2009).

Quite a number of studies have covered teacher self-efficacy in relation to teacher productivity among a host of other dependent variables; however, a few of these studies have been done in Kenya with the rest having been done both in the western and the eastern countries. Among the few researches done in Kenya is one which has ventured into the contribution teacher-efficacy in choosing appropriate pedagogical innovation which was done in Kwale county by Ogembo, Kamau, Ndwati and Monyoro (2016). There were 121 participants. Data was collected using questionnaires. The main finding of the study was that the tutors rated as high their capacity to select and employ suitable instructional techniques in curriculum implementation.

According to the literature and findings of the afore-stated study, it was recommended that there was a need to take into consideration the efficacy beliefs of teachers when subjecting them to professional developing like SMASSE training. In particular, it was necessary to monitor self-efficacy beliefs periodically and that activities designed for enhancing tutors' self-efficacy be intensified at both pre-service and in-service training. It was a strong view of this research that future studies should consider beliefs about science teaching, for an understanding of pedagogy in science for example whether "active" or "passive".

Teachers' effective management of the learning situation has and continues to draw the concern of many researchers (CEMASTE, 2010); this is more so in response to declining standards in learner achievement within the country (Kenya) and the need to keep pace with the rest of the world. Egbo (2011) argues that since teachers are the primary agents in the implementation of the curriculum, their personal perceptions concerning the prevailing conditions as well as their ability to contribute in turning around the circumstances through the use of improved instructional techniques ultimately influences learners' achievement. Personal teacher efficacy is an indicator of their willingness or otherwise to embrace pedagogical innovation such as SMASSE pedagogy. Though data on personal self-efficacy seems to exist, much of this work has its origin largely in developed nations and to a smaller extent in middle-income economies but still outside Africa. Having analyzed available documented works on teacher efficacy in Kenya, it has become apparent that no study has ventured into the subject of the influence of teacher self-efficacy in the transfer of ASEI-PDSI pedagogical skills in Kenya. This justified the choice of present research.

Theoretical Perspectives

Two teacher change models underpinned the current research. The first one is advanced by Guzdial and Ni (2007) and the second one has been postulated by Guskey (2002). According to Guzdial and Ni theory, teachers' knowledge, attitudes, and beliefs will influence their adoption decisions by affecting their understanding and beliefs toward a new teaching strategy, especially their perception of the "fit" or alignment of their needs and what the new pedagogy offers, as well as their confidence in enacting that approach. This kind of perception and self-confidence will determine whether they would like to adopt that new approach or otherwise.

Guzdial and Ni (2007) propose that teachers' knowledge, attitudes, and beliefs about themselves influence teachers' adoption decisions of pedagogical reforms such as ASEI-PDSI pedagogy. Knowledge, attitudes and beliefs that teachers hold about them relate to teachers' perception of the need to change, their interest in change as well as beliefs in their own abilities to change. The foregoing description of teacher attributes is synonymous to teacher self-efficacy. Following are areas of interest in teacher self-efficacy as advanced by this theoretical framework:

- *Perception of the need to change.* Is the teacher satisfied with how he/she currently teaches the subject?
- Or, does one think there is a need to adopt a new pedagogy to improve one's teaching?
- *Personal interest in change.* Does the teacher feel interested/active in trying a new pedagogy?
- *Confidence to change.* Does the teacher feel confident in one's ability to implement a new pedagogy?

Another model proposed on how teacher change should be effected has been advanced by Guskey (2002). According to this theory, a significant change in teachers' efficacy beliefs occurs primarily after they gain evidence of improvement in students' learning. This improvement typically results from changes teachers have made in their classroom practices - a new instructional approach, like in this situation use of ASEI-PDSI pedagogy. The use of new materials or curricula or simply a modification in teaching procedures or classroom format. The model proceeds to state that it is not the professional development *per se*, but the experience of successful implementation that changes teachers' attitude and efficacy beliefs.

This model of teacher change is predicated on the idea that change is primarily an experientially based learning process for the teachers. A practice that is found to work (in this case ASEI-PDSI pedagogy) – is one that teachers find

useful in helping students attain desired learning outcomes –and such an approach is retained and continuously repeated. Equally, a teaching strategy that does not yield tangible evidence of success is generally abandoned. In a nutshell, demonstrable results in terms of students learning outcomes are key to the endurance of any change in instructional practices.

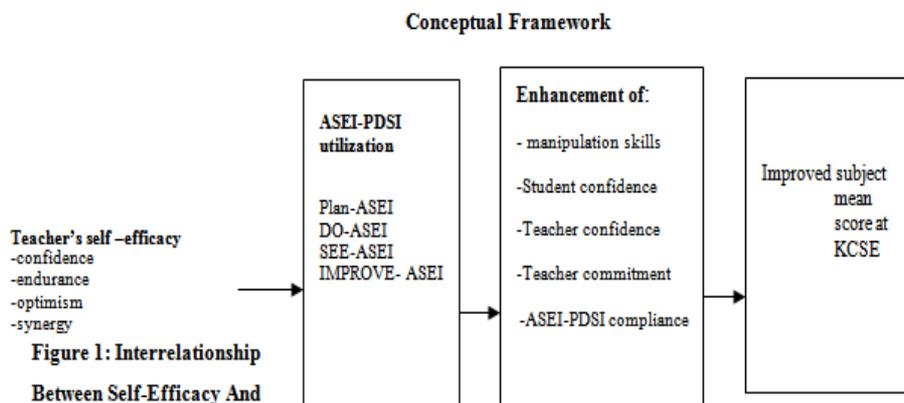


Figure 1: Transfer of ASEI-PDSI Pedagogy

METHODOLOGY

This study used ex post facto design. The target population comprised of 319 public secondary schools, 319 principals, 1412 science teachers and 20125 form four students in Kisii County. The study adopted purposive, quota, stratified and random sampling procedures to select 108 biology teachers, 121chemistry teachers, 88 principals, and 752 forms four students. The research instruments used were questionnaires and observation checklist. The data collected was validated, edited and coded on a daily basis. Quantitative data were analyzed using statistical package for social sciences (SPSS) version 21 and excel software. Descriptive statistics (frequency distribution, percentages, mean and standard deviation) were used to analyze and present data. Pearson product moment correlation coefficient was used to test the hypothesis at 5% level of significance. Data obtained using open-ended questions (in the principals’ and students questionnaires) was subjected to qualitative analysis through content and verbatim analysis.

Findings

Teachers self-efficacy was assessed by requesting science teachers’ to rate the level of their self-efficacy on a scale of 1 to 5 (1-nothing, 2-very little, 3-some action, 4-Quite a lot and 5-A great deal of action). Students were also provided with statements that assessed their perceptions on teachers’ level of self-efficacy. The mean scores obtained in science subjects in KCSE 2016 were used to represent the transfer of pedagogical skills. The students mean scores were transformed into z-score and then t-scores. Findings of the study are presented as follows:

Students Perception of Teachers’ Self-Efficacy

Student participants were provided with 6 statements that assessed their perception of their teachers’ level of self-efficacy. The statements were assessed on a scale of 1 to 5 (1-strongly disagree, 2-disagree, 3-undecided, 4-agree and 5-strongly agree). The sum of the scores obtained by informants was utilized to establish respondents’ level of perception of teachers’ self-efficacy. Given that the sum of items on the scale was 6, the lowest likely score for a person on the scale was 6 (1x6) and the highest practical score was 30 (6x5). The scores were eventually grouped into 3 levels where scores

ranging from 6 to 15 represented low level of self-efficacy, scores ranging from 16 to 21 represented moderate level of self-efficacy and scores ranging from 22 to 30 represented high level of self-efficacy. Summary of the findings is presented in Tables 1 and 2

Table 1: Students’ Perception of Teachers’ Level of Self-Efficacy

Levels of Self-Efficacy	Frequency	Percentage
Low levels of Self-Efficacy	16	2.5
Moderate levels of self-efficacy	61	9.4
High levels of self-efficacy	574	88.1
Total	651	100.0

As demonstrated in Table 1, most (88.1%) of learners indicated that their teachers had a high level of self-efficacy, 9.4% showed that they had a moderate level, while only 2.5% felt that they had a low level of self-efficacy.

Table 4.17 represents the summary of the descriptive analysis of students’ perception of teachers’ level of self-efficacy.

Table 2: Students’ Perceptions of Teachers’ Level of Self-Efficacy

	N	Minimum	Maximum	Mean	Std. Deviation
Self-Efficacy	651	6	30	26.00	4.088

From Table 2, findings indicate that the lowest score attained in the level of self-efficacy was 6, while the highest score was 30. The means score was 26 (SD=4.088), which indicates that the average level of teachers’ self-efficacy according to students was in the high rating. Some of the responses on teacher self-efficacy emerging from data collection portrayed an interesting turn of events. When asked to state whether there were certain behaviors or things that students did not like about their teachers, one student penned in the questionnaire:

“Our chemistry teacher is not the problem, the real issue is with the culture in the school about chemistry; students have been socialized by their senior peers to believe that the subject is impossible to understand or learn. For this reason, every topic of this subject is simply assumed to be complex!”

This student’s observation confirms the fact that effective curriculum implementation is not about teacher quality *per se*, but to school context also. This finding resonates with the result of Korir and Kipkemboi (2014) which established that peer pressure has the potential of transforming students’ beliefs about a subject.

Teachers’ Perception of their Self-Efficacy

Teachers were provided with 15 statements that assessed their perception on their level of self-efficacy. The statements were assessed on a scale of 1 to 5 (1-strongly disagree, 2-disagree, 3-undecided, 4-agree and 5-strongly agree). The sum of the scores reached by the respondents in the overall scale was used to establish science tutors’ level of their perception of self-efficacy. Given that the total number of items on the scale was 15, the lowest attainable score for an individual on the scale was 15 (1x15) and the highest possible score was 75 (15x5). The scores were then classified into 3 levels where scores ranging from 15 to 37 represented low level of self-efficacy, scores ranging from 38 to 52 represented moderate level of self-efficacy and scores ranging from 53 to 75 represented high level of self-efficacy. Summary of the findings is presented in Tables 3 and 4

Table 2: Teachers' Perception of their Level of Self-Efficacy

Levels of Self-Efficacy	Frequency	Percent
Low levels of Self-Efficacy	4	3.2
Moderate levels of self-efficacy	83	66.4
High levels of self-efficacy	38	30.4
Total	125	100.0

From Table 3, the majority (66.4%) of teachers indicated that they had moderate levels of self-efficacy, 30.4% had high levels of self-efficacy, while 3.2% had low levels of self-efficacy. Table 4 represents the summary of the descriptive analysis of the teachers' perception of their level of self-efficacy.

Table 3: Teachers' Perception of their Level of Self-Efficacy

	N	Minimum	Maximum	Mean	Std. Deviation
Self-efficacy	125	34	72	49.72	5.974

As shown in Table 4., findings indicate that the lowest score attained in the level of self-efficacy was 34, while the highest score was 72. The mean score was 49.72 (SD=5.974), which indicates that the average level of teachers' level of self-efficacy was moderate. When asked in the questionnaire how they thought their confidence to effective application of ASEI – PDSI would be boosted, one science teacher observed:

“My Principal does not understand the meaning of improvisation; to him, it refers to a teacher's ability to device ways of obtaining all science equipment which is not available in the laboratory. This seems to be so because every time I inform him of a missing chemical or apparatus all he tells me is: please improvise. Therefore I think my confidence will be greatly enhanced if I am provided with the basic apparatus and chemical in the laboratory”.

Ndirangu (2013) also encountered similar observations from chemistry teachers. One teacher wondered how some apparatus like burettes could be improvised. Clearly, thus, school leaders in Kenya need to be capacity built to understand the meaning of the concept of improvisation. In any case, as the teachers noted, improvisation was lowering the quality of teaching because the materials were substandard. This point of view is in tandem with CEMASTEVA (2016) whose informants (principals) asserted that improvisation invariably compromises the accuracy of results.

Hypotheses Testing

To determine the Relationship between science teachers' self -efficacy and transfer of SMASSE pedagogical skills, the following null hypothesis was tested:

H₀₂: There is no significant relationship between science teachers' self-efficacy and transfer of SMASSE pedagogical skills in secondary schools in Kenya.

Pearson Product Moment Correlation Coefficient was applied to test the hypothesis. The rationale for use of this inferential statistic was that the two variables are measured in the interval scale.

Table 5 displays the results of the Pearson Correlation between teachers' self -efficacy and transfer of SMASSE pedagogical skills.

Table 4: Correlation Between Self-Efficacy and Transfer of SMASSE Pedagogical Skills

		Transfer of Pedagogical skills
Self-Efficacy	Pearson Correlation	.027
	Sig. (2-tailed)	.763
	N	125

The findings in Table 5 show that there was a weak positive relationship between teachers’ self-efficacy and transfer of SMASSE pedagogical skills, $r(125) = .027$, $p = .763$, a relationship that was not statistically significant, $p > 0.05$. From this outcome, the null hypothesis was thus not rejected. The descriptive analysis of the current study gave teachers’ self- efficacy a moderate rating as derived from students’ and principals’ judgment; and on a more or less same measure, the inferential analysis revealed a weak positive relationship between teachers’ self-efficacy and transfer of ASEI-PDSI pedagogy. This implied failure to reject the null hypothesis at the level of significance of $p > 0.05$. Consequently, it was upheld that there was no significant relationship between teacher self- efficacy and transfer of ASEI-PDSI pedagogy. This finding is at variance with several studies (Coladarci, 1992; Young and Huang, 2006; Hsiao, 2011; Ahmad and Tamiz, 2012; and Ereno and Nunez, 2014) who reported a significant relationship between teacher self- efficacy and learners’ achievement. The foregoing studies also showed that teachers with high self- efficacy were better placed in accepting pedagogical innovations like ASEI-PDSI teaching method.

The outcome of the present study on teacher self-efficacy has also been questioned by Enoch and Riggs (1990) who related teacher self-efficacy with teacher professional behavior and revealed a significant relationship. However, the pitfall of this research is that it did not specify the nature or type of teacher professional behavior in question. Furthermore, it did not compare the said tutor behavior with learners’ achievement. The current study’s findings are in concurrence with those carried out by Eberle (2011) and Dibapile (2012) which were done in North Carolina and Botswana respectively where no significant relationship was found to exist between teachers’ self-efficacy and learners’ academic achievement. On this, this researcher is of the opinion that intervening variables might have played a role to obscure the impact of teacher self-efficacy on learners’ academic achievement. In particular, learners’ low entry behavior was reported by CEMASTE A (2016) to be responsible for the poor science performance registered in KCSE examination.

CONCLUSIONS AND RECOMMENDATIONS

The current study revealed a moderate teachers’ self-efficacy as indicated from students and principals’ perception; and on a more or less measure, the inferential analysis showed a weak positive relationship between teachers’ self-efficacy and transfer of ASEI-PDSI pedagogy. It was therefore inferred that teacher self-efficacy did not inform transfer of ASEI-PDSI pedagogy in Kenya. It was then recommended that school leaders pursue appropriate strategies to develop and nurture self-efficacy in their science educators.

REFERENCES

1. Aminata, S. (2015). *Effect of Strengthening of Mathematics and Science in Secondary Education (SMASSE) pedagogy on girls' mathematics achievement in secondary schools in Nairobi, Kenya. Unpublished Ph.D Thesis, University of Nairobi.*
2. Ahmad, M. & Tamiz P. M. (2012). *The impact of teacher self-efficacy on students motivation and achievement. Journal of Theory and Practice in Language studies, 2(3), 483-491.*

3. Ashton, P. (1986). *Making a difference: Teacher sense of efficacy and student achievement*. New York: Longman.
4. Asokhia, M.O. (2009). *Improvisational/teaching Aids: Aids to effective teaching of English language*, *international journal of educational science* 1(2) 79-85.
5. Aurah, C. & McConnell, T. (2014). *Comparative study on pre-service science Teachers' self-efficacy beliefs of teaching in Kenya and the United states of America*. *American Journal of Education research* 2(4), 233-239.
6. Bagaka, G. J. (2011). *Role of teacher characteristics and practices on upper secondary school students' mathematics self-efficacy in Nyanza province of Kenya: A multilevel analysis*. *International Journal of science of mathematics education* 9(4), 817-842.
7. Bandura, A. (1977). *Self-efficacy: Towards a unifying theory of behavioral change*. *Journal of psychology review* 84(2), 479-507.
8. CEMASTE A, (2010). *Popularising Student-centred learning in Kenya: Looking Without to Improve*
9. *Supervision of ASEI-PDSI at School Level in Kenya*.
10. CEMASTE A (2011). *A situational analysis on implementation of SMASSE project in Kenya*, CEMASTE A: Nairobi
11. CEMASTE A (2016). *Secondary school principals' workshop report*. Ministry of Education, Nairobi.
12. Coladarci, T. (1992). *Teachers' sense of efficacy and commitment to teaching*. *Journal of Experimental Education* 60 (4), 322-337.
13. Dellinger, A. B. (2008). *Measuring teachers' self-efficacy beliefs*. *Journal of teaching and teacher education* 24(6), 751-766.
14. Eberbille, W. M. (2011) *Teacher efficacy and student achievement as measured by North Carolina reading and end of grade tests*. *Electronic Thesis and Dissertation*. Paper 1242. [http:// dc.etsu.edu/etd/1242](http://dc.etsu.edu/etd/1242)
15. Egbo, B. (2011). *Teacher capacity building and effective teaching and : a*
16. *seamless connection*. *Mediterranean Journal of Social Sciences*, 2(5)
17. Enosh, L., & Riggs, I. M. (1990). *Further development of an elementary science teaching efficacy instrument: Apre-service elementary scale*. Available online: <https://www.springer.com.>document>.
18. Ereno, J. A. (2014). *What makes a teacher a better teacher? A hierachical regression analysis of self-efficacy and commitment as predictors of faculty members job performance*. *Journal of Asian Social Sciences* 4(4), 492-498.
19. Evers, W. J. G., Brouwers, A, & Tomic, W. (2002). *Burn out and self-efficacy: A study on teachers beliefs when implementing an innovative educational system in the Netherlands*. *British Journal of Educational Psychology*, 71., 227-243.
20. Faize, F.A Dahar, M.A (2011). *Physics teachers' competence in practical skills. A comparison of "O" level and federal Board students' view in Pakistan*, *European Journal of social sciences*.

21. Gibson, S. A. & Dembo, M. (1984). *Teacher efficacy: A construct Validation. Journal of Educational psychology*, 76., 569-582.
22. Guskey, R. T. (2002). *Professional development and teacher change. Journal of Teachers and Teaching:theory and practice*, Vol.8, No.3/4.
23. Guzdia, M. & Ni, L. (2007). *What makes Teachers Change? Factors that Influence post – Secondary Teachers Adoption Of New ComputingCurricular. Technical Report GT-IC-08-02. Washington: MITRE*
24. Henson, R. (2001). *Teacher self-efficacy: Substantive implications and measurement dilemmas. Paper presented at the annual meeting of the research exchange. College station, Texas.*
25. Hsiao, H. A. (2011). *The influence of teachers' self-efficacy on innovative work behaviour. Paper presented in international conference on social science and humanity. Singapore.*
26. Jassen, O. (2000). *Job demands, perception of effort-reward fairness and innovative work behaviour. Journal of occupational and organisational psychology* 73, 287-302.
27. JICA,(2007). *Report on the Final Evaluation of Phase II of SMASSE Project. Unpublished, Nairobi, CEMASTE A.*
28. Kidman, G. (2012). *Australia at crossroads: A review of school sciencepractical work Eurasia Journal of Mathematics, science and technology education*, 8(1), 35-47.
29. Korir,K. D. & Kipkemboi, F. (2014).*The impact of school enviroment andpeer influence on students' academic performance in Vihiga County, Kenya. Journal of Education and Practice*, 5 (11).
30. Kumar, R. & Uz Kurt, A. (2006). *Investigating the effect of self-efficacy on thennovativeness and the moderating impact on cultural dimensions.Journal of interanational Business and Cultural studies in press.*
31. Muwanga – Zake, J.F.W (2001). *Is science education in a crisis? Some of the problems in south Africa. Science in Africa online magazine. Available at www.scienceafrican.co.za/scirisis.htm accessed: Nov. 4, 2018.*
32. Ndirangu, C. W. (2013). *Factors influencing teachers' level of implementation of SMASSE innovation in Nyeri County, Kenya. Unpublished PhD Thesis, University of Nairobi.*
33. Odanga, J.O.S, Raburu A.P. & Aloka, P.T.O (2018) *Strategies for enhancing teachers self-efficacy in secondary schools in Kisumu County.Asian Research Journal of Arts and Social Sciences* 6(2): 1-13.
34. Ogembo, J. K., Kamau, J.O. Nduati,S.C. & Monyoro, W.M. (2016). *Influence of prrsonal teacher efficacy on selection of teaching methods in secondary schools in Kwale county, Kenya. International Journal of Humanities & Social Sciences Education*, 3(3), 69-77.
35. *Republic of Kenya, (2015).Ministry of Education Science and Technologynational education plan (2013-2018). Jogoo House, Nairobi.*
36. Schunk, D. (1991). *Self-efficacy and academic motivation. Journal of Educational Psychologist* 26(3)., 207-231.

37. Schunk, D. (2012). *Learning theories: An educational perspective (6th edition)*. London: Pearson.
38. SMASSE INSET, (2010). *Secondary school situational analysis: A Paper presented at principals and deputy principals workshop on supervision of ASEI-PDSI at school level in Kenya*.
39. SMASSE Project, (2007). *Report on survey of Impact of SMASSE INSET in Kenya*. CEMASTE, Nairobi.
40. SMASSE project (2010). *Report on 2nd workshop on effective operation of SMASSE project held at KSTC on 22nd and 23rd May 2000*
41. SMASSE(2009). *The ASEI movement*; Available online <http://www.smasse.org>
42. SMASSE, (1999). *The baseline studies, Nairobi, SMASSE. Unpublished*.
43. SMASSE, (2002). *Effective operation and management of SMASSE project*. CEMASTE, Nairobi.
44. Tschannen-Moran, M. (2007). *The differential antecedents of self-efficacy beliefs of novice and experienced teachers*. *Journal of Teaching and Teacher education* 23(6), 944-956.
45. Tschannen-Moran, M. A. (2009). *Sources of self-efficacy: Four professional development formats and their relationship to self-efficacy and implementation of a new teaching strategy*. *Elementary school journal*
46. Woolfolk-Hoy, A. (2000). *Changes in teacher efficacy during the early years of teaching*. Paper presented at the annual meeting of the American Educational Research Association. New Orleans: L.A.
47. Yang, H. & Huang, X. (2006). *The self-efficacy and job involvement of clinical nursing teachers*. *Journal of Nursing Research*, 14 (3), 237-249.
48. Makewa, L. N., Role, E. M., & Biego, S. (2011). *Teachers' attitude towards strengthening mathematics and science in secondary education through in-service education and training (SMASSE-INSET) Project in Nandi Central District, Kenya*. *International Journal of Education and Social Sciences (IJESS)*, 1(4), 1-5.