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School Factors Influencing the Adoption of Physics SMASSE Teaching Skills by Physics Teachers in Secondary Schools in Kenya

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Abstract

The program SMASSE was introduced in Kenya in 1998, to address the poor performance that existed in science and mathematics subjects at KCSE and to make learners like the subjects. These goals have since not been realized particularly in physics where the national mean score has to date remained below average. The purpose of this study was to assess school related factors influencing the adoption of physics SMASSE teaching skills in secondary schools in Uasin Gishu County. The study utilized descriptive survey research design and was guided by Cognitive Response Theory by Ortony, Clore and Collins. The study targeted 177 secondary school principals, 214 physics teachers and 34705 Physics students in Uasin Gishu County. The study included a sample size of 125 principals, 152 physics teachers and 1632 physics students who were selected using simple random sampling. All the principals of the selected schools were included in the study. The data from teachers was collected using questionnaires and observation, structured interview guide for principals, focused group discussion for students and document analysis at county director's office for schools data. Data was analysed using percentages, frequencies and chi-square. The study established that availability of physics learning resources, leadership support, school location, school programs, class size, school culture and school type influence the adoption of physics SMASSE teaching skills in secondary schools in Uasin Gishu County. The findings of this study will be useful to the Ministry of Education and the entire Education stake holders to ensure the skills learned in SMASSE are implemented in order to enhance the performance of students in physics subject.

Keywords: SMASSE; adoption; school-factors; teaching skills; physics.

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1. Introduction

Kenya has a goal of being industrialized by the year 2020 and attain goals under vision 2030 [1,2] and to become a newly industrialized, middle level income country providing high quality life for all its citizens by the year 2030. Physics is one of the sciences that explains the essence of natural phenomena and helps people understand the increasing technologically changing society [3]. From the year 2004, Kenya and Japan implemented a bilateral technical cooperation pilot INSET project for capacity building in mathematics and science education for teachers and education managers. Although dismal performance in these subjects had almost been accepted as the norm in some schools, the Ministry of Education Science and Technology (MoEST) and other stakeholders felt there had to be an intervention, hence the Strengthening of Mathematics and Science in Secondary Education (SMASSE) Project.

Becker revealed that positive factors which encourage teachers' use of innovations to include collegiality among computer-using teachers at the school, school support, resource available for staff development and smaller class sizes [4]. These indicating that certain particular school characteristics can affect teacher adoption of innovation. Locally, Migwi in his study in Gatanga district on impact of SMASSE on teaching and learning of Chemistry revealed that school principal support enhanced implementation of SMASSE skills by the teachers [5]. In Uasin Gishu County, Nekesa in her study on effect of SMASSE training on teaching and learning of chemistry revealed that some teachers continued using teacher- centered approaches in teaching contrary to SMASSE teachings [6]. This means that implementation of SMASSE skills by teachers in Uasin Gishu County is not 100%, but there are varied degrees of implementation. What causes these varied degrees of implementation of SMASSE skills by physics teachers is the main interest of this study. This shows the existence of a problem somewhere even after the GoK spends heavily to train teachers on SMASSE and the relevant skills imparted on the teachers appear not to reach the classroom which is the intended destination. Hence this study sought to determine the influence of school-factors on the adoption of physics SMASSE teaching skills in secondary schools in Uasin Gishu County.

1.1 Statement of the Problem

The government of Kenya is committed to the provision of quality education, training and research as a human right for all Kenyans in accordance with Kenya's Constitution and International conventions. Further, the government of Kenya recognizes the important role science and mathematics should play in the realization of vision 2030 to become a globally competitive and prosperous country by the year 2030. This is why the government started SMASSE initiative in the year 1998 which was in response to students continued poor performance in the science and mathematics subjects at KCSE. The strategy aims at improving performance of students at KCSE in sciences and mathematics and also to make learners like the subjects through capacity building of the relevant teachers. However, this has not been the case considering National and even County statistics. The Physics subject has for the last 5 years upto year 2012 registered mean scores that are below average; the popularity of Physics has also not improved significantly among students compared to the case in Biology and Chemistry. Students who select physics have been about a quarter of those selecting chemistry or biology subjects. The national KCSE physics mean score in the year 2013 and 2014 was 40.10 percent and

38.84 percent respectively, an indication that the situation was getting worse. The situation in Uasin Gishu County has been the same with physics subject registering a mean score of 5.9744 in KCSE 2012, year 2013 mean score was 5.8004 and the candidate population being far lower than in chemistry or biology subjects. This is why the current study was conducted to establish the school-factors that influence the adoption of SMASSE skills by the physics teachers in Uasin Gishu County.

HO_1:There is no statistically significant relationship between school-related factors and adoption of physics SMASSE teaching skills.

1.2 Constraints of the Study

These are aspects that can easily influence the results negatively, over which the researcher has no control. This study used questionnaires which produced self report data which is not verified. However the use of triangulation i.e. use of a variety of data collection instruments e.g. interview schedule, participant observation, focused group discussion and document analysis helped to minimize this problem. This study was a cross-sectional one which yielded snap-shot data .i.e. information is got as they are at the time of data collection, what happened before and in future is not captured. Hence the assumption was that what would be captured is the true picture of the situation before and in future. A content analysis was done to minimize the problem.

1.3 Literature Review

Exploring the effects school factors, like leadership support for teachers and school resources is important to determine level of students' achievements in a subject [7]. This is important because workplace conditions can exert powerful influence over the quality of teaching in two main ways: by helping to attract and retain quality people into teaching and by energizing teachers and rewarding their accomplishments. This means that to enhance student achievements in a subject there is need to make the school environment attractive to teachers and students and also ensure that the work place is rewarding to the teachers. Reference [8] while conducting a study on factors that influence post-secondary teacher adoption of new computing curricular in Atlanta revealed that teacher excitement over the new course drives adoption, while systematic issues such as course content, preparation time, working on course materials, unified departmental curriculum inhibited adoption [8].

Institutional factors help to improve teachers' existing attributes. Teachers' time committed to teaching and amount of technology training are reliable factors of technology use in classroom [9]. They asserted that teacher trainers and administrators should not only provide extensive training on education technology, but schools also facilitate a contribution to teaching improvement. This study intends to provide education administrators with additional information to help manage the dissemination of SMASSE project successfully. Harris, Poikot and Soloway also pointed out to the importance of access to technology and that an understanding of institutional characteristics that influence teachers' adoption and integration of innovation into teaching is relevant [10].

Availability of classrooms that are spacious and accommodative to all physics students is good for learning. A physics classroom would also require some space within the classroom for some physics practical demonstrations and activities, large class sizes are therefore an issue, connection to power supply for the classroom, as well as availability of natural light may be important when a teacher is tackling some topics in physics. The laboratory is also an important facility when it comes to the teaching and learning of physics at secondary school level in Kenya. The physics learning materials such as reagents used in battery accumulators, equipment used in measurement, density determination among others are quite important in the teaching and learning of physics subject [11]. Plomp, Anderson, law and Dwale also said access to relevant technological infrastructure and resources in schools is a necessary condition to the integration of technological innovations in education [12].

Adoption of the decisions that individuals make each time that they consider taking up an innovation is based on knowledge of the support by the school leadership among other factors. The principal is instrumental in ensuring that SMASSE project succeeds in his/her school [13]. The school principal is expected to encourage and motivate teachers to practice SMASSE at school level. Although infrastructure support is imperative to innovation adoption by teachers, school technology leadership is a stronger predictor of teachers' use of technological innovations in teaching [14]. The kind of leadership and support the school principal, Board of management and the education officials is important in influencing the teacher to decide to adopt an innovation in teaching. A leader who implements technology plans and also shares a common vision with the teachers stimulated them to use innovations in their lessons [15]. a relationship between the head teachers' level of computer competence and transformational leadership practices they concluded that transformational leadership could help improve the integration of technology into teaching and learning processes[16]. Andoh revealed that the school level factors such as leadership support, funding, training and facilities did influence teachers' adoption and integration of innovation into their classroom teachings [17]. In Kenya a study by Migwi revealed that school principal support was important in ensuring the implementation of SMASSE skills [5]. The current study sought to find out if leadership support is a factor that could influence adoption of physics SMASSE skills in Uasin Gishu County.

Lijon and Guzdeal while studying on factors that influence post-secondary teachers adoption of new computing curricula revealed that the barriers that prevented teachers from integrating technological innovations in their teaching included, course content, preparation time, Time for working on course materials and unified departmental curricula[18]. The course content, if too much, could cause a challenge to a teacher who wants to adopt a new innovation to his/her teaching. A study by Neyland on factors influencing the integration of innovations in teaching among secondary schools in Sydney revealed that increased workload of teachers was alarming and hence asking teachers to take on board another task in an already overcrowded curriculum and extremely busy work day was a toll order for the teachers. Hence the workload given to the teachers was seen to be a major factor in influencing teachers to adoption to innovations such as SMASSE in their teaching [19].

Balanskat and his colleagues categorized the factors that prevent teachers from innovation use in their teaching as: School level and system level barriers [20]. The school level barriers comprise school characteristics that may prevent teacher adoption of information e.g absence of the relevant infrastructure, old and poorly maintained hardware, lack of suitable educational software among others, the system-level barriers include rigid structure of traditional education systems, traditional assessment systems, restrictive curricula and restricted organizational structure. This school culture therefore may become a hindrance to teachers implementing physics SMASSE skills in their teaching. The major barriers of use of innovations by teachers were rigid school syllabi, inadequate motivation, lack of strong leadership and inadequate cooperation among teachers among other factors. Some schools have in their culture ways of motivating the teachers for good work done. Where the teacher does not expect any motivation, a teacher may decide not to adopt an innovation in their teaching [21].

The space in the classroom coupled with the large class size may make it difficult for a teacher to include student centered demonstrations, illustrations and experimentation in the lesson. Reference [21] reported that barriers to use of innovations in classroom teaching include congested classes among other factors [21]. These include administrative factors which are class size, groupings and policies. Effects of class size on classroom processes tend to fall into two main camps, i.e teacher-pupil interaction and pupils classroom engagement [22]. Reference [23] ford and his colleagues showed that although there was a heavy reliance on whole class teaching and individual work in primary schools, pupils in small classes were more likely to experience one to one teaching and were more often the focus of a teacher’s attention. A study on large class teaching in resource-constrained context among Ugandan primary schools, revealed that while teachers can do what is in their means to facilitate teaching and learning in large classes, they would still need a lot of institutional and policy support [23].

According to Sam and Herbers, student motivation is strongly affected by the way a school operates and in turn, influences the school performance in terms of leaning outcomes [24]. While the schools impact on student motivation is significant for students in all schools, it is especially important where the community context, whether rural or not, is anemic in engendering high value for education and laden with adolescent pursuits such as dating, sports and outside work that vie with academic achievement for young people’s time and interests. The young people’s interests and beliefs are affected greatly by the environment, whether rural or urban.

Some rural communities and schools may present unique challenges for education, poverty rate is rising in some rural schools [25] and their communities suffer from a paucity of social and behavioral services for families [26]. Parents in rural schools attend school events more often than in urban and sub-urban communities, but they also talk less often with their children about school programs and interact less frequently with teachers than parents in other settings [27]. Because of rural schools centrality within the community, they routinely connect with families in multiple capacities as part of typical daily routines [28].

In Britain and the Netherlands that availability of technical support to help teachers integrate an innovation in teaching is crucial in making the teacher decide to use the innovation. Technical support is more easily accessed in urban areas than in rural areas. A teacher imagining lack of technical support in an area may opt not to adopt an innovation that may require such technical support [29]. Most rural primary school pupils, compared with their urban counterparts, are generally faced with poverty, poor reading ability and limited exposure to real technological applications [30].

1.4 Research Methodology

This study adopted a descriptive survey research design and was guided by the cognitive response theory by

Ortony and his colleagues [31]. This study was conducted in Uasin Gishu County. The study population involved all secondary schools in Uasin Gishu County among which there were private, national, extra county, county and district schools. There were 177 secondary schools in Uasin Gishu County. The research involved all teachers of physics, secondary school students of physics and principals of secondary schools in the county. In this study all the 177 secondary schools in the county were stratified as national, extra county, county, sub-county and private schools. For the purpose of this study sample sizes was determined using sample size table by Krejcie, Robert, Morgan and Daryle. All the 125 head-teachers of the selected schools participated in this study. Simple random sampling was used to select a maximum of two physics teachers per selected schools (where the number was two or less, they automatically were included in the sample). Therefore, 152 teachers, 1632 students and 125 head teachers participated in this study, making a total sample of 1909 respondents. The data collection instruments used were questionnaire, interview schedule, observation and document analysis. The data collected was organized, presented, analyzed and interpreted using descriptive and inferential statistics. Descriptive statistics that were used included frequencies, percentages and means. The inferential statistics chi-square (x^2) was used to test the hypothesis and verify on the relationship between the teacher factors and adoption of Physics SMASSE skills.

1.5 Findings

The study sought to determine the school factors influencing the adoption of SMASSE skills by physics teachers. The teachers who participated in this study were asked to rate the items in this section according to the extent to which they agree or disagree with them. There were 14 items measuring school factors. The responses were coded as 1 = strongly agree, 2 = agree, 3 = undecided 4=disagree, and 5 = strongly disagree. While scoring the questionnaires the highest possible score for each item on the likert scale was 5.0 points and the lowest was 1.0. The highest possible mean score for a respondent was 5.0 and the lowest was 1.0. The midpoint was taken to be 3.0 and this was used to categorize responses as either “agree” or “disagree”. For each item a mean and standard deviation were calculated. The results are presented in Table 1.

Table 1 shows that majority of the teachers stated that scarcity of physics learning resources influences the physics teachers’ adoption of physics SMASSE skills. This variable had a mean of 2.4207 and standard deviation of 1.11598. Similarly, majority of the teachers who participated in this study asserted that lack of suitable physics laboratories can discourage a teacher from adoption of physics SMASSE skills(mean=2.2345, SD=1.04093). It is further shown that the respondents agreed that lack of relevant physics learning materials and equipment can discourage the physics teachers adoption of SMASSE skills in teaching(mean=2.4000, SD=1.12052).

Majority of the teachers were of the opinion that lack of suitable classrooms with enough space to perform demonstration can discourage the physics teacher adoption of SMASSE skills in teaching (mean=2.4207, SD=1.07799). Further, teachers were of the view that large class size that outstrips existing resources can discourage the physics teachers’ adoption of SMASSE skills in teaching (mean=2.4621, SD=1.14273). School culture influences adoption of physics SMASSE skills by physics teachers as stated by majority of the teachers who participated in the study (mean=2.3310, SD=1.05446). The variable ‘school leadership support influences adoption of physics SMASSE skills in teaching' achieved a mean of 2.9448 and standard deviation of 1.20057. This indicates that majority of the teachers who participated in this study agreed that school leadership support influences adoption of physics SMASSE skills in teaching.

Table 1: School Factors (N=145)

Statement	**Mean**	**Std. Deviation**
Scarcity of physics learning resources influences the physics teachers' adoption of physics SMASSE skills.	2.4207	1.11598
Lack of suitable physics laboratories can discourage a teacher from adoption of physics SMASSE skills.	2.2345	1.04093
Lack of relevant physics learning material and equipment can discourage the physics teacher adoption of SMASSE skills in teaching.	2.4000	1.12052
Lack of suitable classrooms with enough space to perform demonstrations can discourage the physics teacher adoption of SMASSE skills in teaching.	2.4207	1.07799
Large class sizes that outstrip existing resources can discourage the physics teacher adoption of SMASSE skills in teaching.	2.4621	1.14273
School culture influences adoption of physics SMASSE skills by the physics teachers.	2.3310	1.05446
School leadership support has no influence on adoption of physics SMASSE skills in teaching.	2.9448	1.20057
Guidance and moral support given by the school management on SMASSE can encourage a teacher to adopt physics SMASSE skills in teaching.	2.2483	1.02423
Motivation of some form either by promotion, commendation or certification can best influence the physics teacher to adopt physics SMASSE skills in teaching.	2.3448	1.05000
Volume of School programs in general has no influence on adoption of physics and SMASSE skills by the teacher in teaching.	3.0276	1.19574
A teacher with a heavy workload on the timetable can be discouraged to adopt physics SMASSE skills in teaching.	2.2966	.97983
A school timetable that does not provide for ample time per lesson to conduct practical lessons can discourage a teacher from adopting physics SMASSE skills in teaching.	2.2000	1.00416
Location of the school whether urban or rural has no influence on the adoption of Physics SMASSE skills by the teachers.	3.0345	1.18681
Single sex schools provide best environment for adoption of SMASSE skills than mixed schools	2.8276	1.13250

It was also established that guidance and moral support given by the school management on SMASSE can encourage a teacher to adopt physics SMASSE skills in teaching (Mean=2.2483, SD=1.02423). Majority of the teachers stated that motivation of some kind either by promotion, commendation or certification can best influence the physics teachers to adopt physics SMASSE skills in teaching (mean=2.3448, SD=1.05000). Volume of school programs have influence on adoption of physics SMASSE skills by the teachers in teaching as indicated by a mean of 3.0276 and standard deviation of 1.19574. Majority of the teachers who participated in this study stated that a teacher with heavy workload on the time table can be discouraged to adopt physics SMASSE skills in teaching (mean=2.2966, SD=0.97983). More than half of the respondents stated that a school timetable that does not provide for ample time per lesson to conduct practical lessons can discourage a teacher from adopting physics SMASSE skills in teaching(Mean=2.2000, SD=1.00416). It should be noted that location of the school has an influence on the adoption of physics SMASSE skills by the teachers (mean=3.0345, SD=1.18681). As shown in Table 1, single sex schools provide best environment for adoption of SMASSE skills than mixed schools (mean=2.8276, SD=1.13250). Further, chi-square was used to test the hypothesis:

HO_1:There is no statistically significant relationship between school factors and adoption of SMASSE skills by physics teachers.

a chi-square of 30.483, d.f. =4 and p-value of 0.000 was obtained. Since $p<0.05$, the null hypothesis is rejected which implies that there is a significant relationship between school factors and physics teachers' adoption of physics SMASSE skills. As stated by the head teachers, availability of physics learning resources have an influence on the physics teachers' adoption of physics SMASSE skills. This means that a well-equipped physics laboratory and spacious classrooms are important to make a teacher comfortably adopt physics SMASSE skills in teaching. The head teachers interviewed also asserted that school culture influence adoption of SMASSE skills by a physics teacher when teaching.

1.6 Conclusion

The study established that scarcity of physics learning resources, lack of suitable physics laboratories, lack of relevant physics learning materials and equipment, lack of suitable classrooms and large class size can discourage the physics teachers' adoption of SMASSE skills in teaching. School culture, guidance and moral support given by the school management, teacher motivation and volume of school programs also affects the adoption of physics SMASSE skills by the teachers in teaching. A teacher with heavy workload on the time table can be discouraged to adopt physics SMASSE skills in teaching. Further, a school timetable that does not provide for ample time per lesson to conduct practical lessons can discourage a teacher from adopting physics SMASSE skills in teaching.

1.7 Recommendation

It is evident that adequacy of teaching and learning resources enhances adoption of physics SMASSE skills in teaching. Hence there is need for ministry of education and other education stakeholders to ensure adequacy and suitability of physics learning resources in secondary is realized. For better adoption of physics SMASSE, there is need to extend the time for practicals for easy development of ASEI-PDSI lesson.

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