Influence of Science Club Activities (SCA) On Secondary School Students' Interest and Achievement in Physics in Vihiga County of Kenya

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Abstract- The school curriculum consists of formal, informal and non-formal dimensions. Secondary schools in Kenya, however, tend to emphasize formal curricular activities. Non-formal activities (NFA) are given less emphasis. Little was known regarding the contribution of non-formal curricular of science club activities (SCA) on students' interest and achievement in Physics. In Vihiga County of Kenya, participation in SCA is poor with only 25 per cent rate of participation of schools. Yet students' achievement in Physics in the County has been low with mean grade of D over the years 2006 to 2014. The purpose of this study was to determine the influence of SCA on secondary school students' interest and achievement in Physics in Vihiga County. This study established scope of participation in science club activities (SCA), established students' achievement in Physics, compared achievement and interest of participants and non-participants in SCA, and established teacher perceptions of SCA in secondary schools in Vihiga County. The study applied descriptive survey and correlational design. The target population was 1500 Form Four Physics students and 80 teachers of Physics. The sample size was 217 students and 60 Physics teachers from 114 schools. The schools were stratified and then sampled using simple random sampling technique. Instruments for data collections were Student Motivation Questionnaire (SMQ), Teacher Questionnaire (TQ), Science Patron Interview Schedule, and Physics Achievement Test (PAT). Results showed that generally performance of participants of science club activities (SCA) was better than for the non-participants. Further the study revealed that SCA contributed to student learning and achievement in Physics at secondary school.

Index Terms- Science Club Activities (SCA), student interest and academic performance in Vihiga County Kenya

I. INTRODUCTION

Science is basically the foundation of technology innovations. Nations, including Kenya are striving to develop technologically and scientifically. The world is turning scientific and our lives depend on science. Physics education is fundamental for sustainable scientific and technological development in the contemporary society (EU, 2004). Besides the economic benefits of Physics, it equips the youth with basic skills of innovation, creativity and prepares them for careers in science and technology. Despite the benefits, much needs to be done to enrol many students to the subject in secondary schools. Developed countries experience decline in students' interest in science, achievement and recruitment for students to science courses (EU, 2004).

Decline in student interest applies to all the science subjects from primary to secondary level but is pronounced more in Physics subject (Sjoberg & Schreiner 2005). The perceived lack of relevancy of science curriculum is one reason for adolescents' low interest and lack of motivation to pursue science in higher education (Sjoberg & Schreiner, 2005). Becoming a scientist is less attractive career aspiration for young people in modern societies.

According to Onasanya and Omosewo (2011) Physics education is faced with problems which limit its impact in Nigeria and the rest of Africa. The researchers argue Physics is mostly perceived to be difficult by many students in school. A study by Owolabi (2004) revealed poor performance of Nigerian students in Physics at Ordinary Level. Factors cited to contribute to poor performance are lack of laboratory facilities, inability of Physics teachers to communicate ideas and inadequate learning facilities in schools against increase in enrolment of students in the subject.

In Kenya, Physics curricular challenges range from methodological issue, lack of personnel, to political, economic and cultural factors (Okere, 2000). Other critical issues that affect Physics curriculum implementation in Kenya include: the difficulty and abstractness of certain topics; mismatch between language of instruction and the commonly used language; shortage of appropriate books; pressure of examination-oriented curricular and lack of adequate and relevant Physics apparatus (Changeiywo, 2002). This affects delivery of Physics syllabus content and in turn leads to negative attitudes among learners and hence poor performance in national examinations.

The average national performance in Physics in Kenya lies between 20 per cent and 40 per cent (Akweya, Twoli,& Waweru 2015, Wachanga, Changeiywo & Barchok, 2005). This performance is equivalent to two (2) or three (3) points on a twelve (12) point grading system used by the Kenya National Examination Council (KNEC). This dismal performance in Physics nationally prompted the Government of Kenya through the Ministry of Education Science and Technology (MoEST), with assistance of the Government of Japan through Japan International Co-operation Agency (JICA), to start a programme

for Strengthening of Mathematics and Science in Secondary School Education (SMASSE). The programme focuses on improving teaching methods among teachers and encourages hands-on activities for leaning (Changeiywo, 2000).

Previous, researches addressing the challenges of teaching and learning of Physics in secondary schools in Kenya have focused on classroom environment (Eshiwani, 1983, Mondoh, 1999, Changeiywo, 2002, Ndirangu & Chege, 2002). Andrew (2006) observed students learn effectively through active learning methods such as project work, field trips and science club activities. In contrast, Okere (2000) who surveyed the status of Physics teaching and examinations in Kenyan secondary schools found that teachers hardly use field trips and project work in teaching. The findings revealed that teachers do not employ field trip strategy at all in their schools although many learning sites were available around the schools.

Performance in Physics is poor in most secondary schools in Vihiga County according to Western Provincial Director of Education statistics (2007) and Vihiga District Education officer statistics (2007). The statistics reveal that students who attempted Physics examinations at Kenya Certificate of Secondary Education (KCSE) score grade D and below. The statistics further show low enrolment in the subject. Still, research indicates students have negative attitude towards Physics and SCA are hardly evaluated in Continuous Assessment Tests (CATs), end-term examinations and KCSE examinations (Akweya et al 2015, Changeiywo, 2000).

II. NON-FORMAL ACTIVITIES AND ACADEMIC PERFORMANCE

Parental involvement, sports and music have all been found to influence children academic performance. The way children choose to spend free time affects their school performance. It is not simply traditional class instruction that impacts academic achievement. Literature indicates a positive correlation between student achievement and engagement in non-formal curricular activities of field trips, clubs and science competitions. A study by American Institutes for Research (2005) which examined the effects of outdoor education on the youth in Califonia showed positive impact. The results showed that 225 students involved in out of class activities experienced an average 27 per cent gain in science scores as measured by pre and post test scores of the experiment. The performance on the two tests revealed a gain for the length of the study with no significant loss in the score after ten weeks. Another research revealed that regardless of students' background and prior achievement, various parenting, volunteering, and home learning activities positively influenced students grades (Simon, 2001). In a study on effects of fieldwork on student achievement and motivation in science education, Andrew (2006), found after one semester with seven fieldwork experiences the general population of students experienced a significant seven percent increase in achievement from the pretest to posttest results. Fieldwork increased student achievement because the students observed science and its applications in the real natural world (Braund & Reiss, 2006).

Adeyemo (2010) in a study looked at the relationship between students' participation in school based non-formal activities and their achievement in Physics in Lagos State of Nigeria. He analyzed data from a survey of two hundred students of senior secondary III Physics students. The research investigated non-formal activities of sports, debating, school clubs, music, dance and other related social activities. Result showed, participating in non-formal activities influenced student achievement in Physics and non-participation in the activities lead to poor academic achievement. Adeyemo further noted other than academic achievement, non-formal activities taught students real life skills of leadership, cooperation, social negotiation and reduced drug and a alcohol use among students.

The primary aim of providing science club activities (SCA) in secondary schools in Kenya is to motivate students and promote the value of Physics in the society (KIE, 2006). The SCA require: costly materials for certain projects to be accomplished, teacher effort, expensive travel bills for hiring and fuelling buses and accommodation of teachers and students and in case they travel to far places.

Studies discussed above are about the effect of fieldwork and other outdoor teaching activities and indicate there is positive correlation between non-formal activities and students' achievement and interest. A study by Adeyemo (2010) focused on Physics subject in Nigeria while the rest are experimental and originate from the developed countries. However, Adeyemo's study did not focus on specific non-formal science activities and used a sample from three secondary schools. This study therefore focused on non-formal activities of SCA in co-operated in Kenya secondary education to improve learning of science subjects and used a larger population of students.

III. METHODOLOGY

This study involved a sample of 217 students drawn from 20 secondary schools and 148 were male and 69 female based on Yamane (1968) formula for calculation of sample size. The participants were selected at form four (4) level of the secondary school in Vihiga County. The research employed a non-experimental correlational design which observed behaviour in naturally setting without manipulating the independent variable. Correlational analysis was applied to establish relationships between independent and dependent variables of the study. The design allowed for drawing of more than one sample from the population at a time and carrying out an in-depth study of variables (Mutuku, Mutiso & Mbatha, 2007). It enabled the researcher to describe the characteristics of population and make a prediction about the populations. To arrive at a unified view of different opinions held by students and teachers on Science Club activities (SCA) the design was ideal.

This study investigated at the influence of Science Club Activities (SCA) on secondary school students' on Physics achievement Test (PAT). Interest and motivation towards Physics in this study was operationalized as the score from 7 to 35 on Student Motivation Questionnaire (SMQ) with 35 signifying higher interest or motivation. Students' achievement in Physics in this study was operationalized as the mark from 0 to 60 on Physics Achievement Test (PAT) with 60 signifying highest achievement in Physics

IV. RESULTS AND INTERPRETATION

Participants of Science Club Activities (SCA) by gender

Table 1: Gender and percentage participation in science club activities (SCA)

Gender	Science Club Activities Membership	
	Number	Percentage %
Female	69	33
Male	148	64
Total	217	100

Table 1 indicates that a majority of students in the study were male at 64% while female were 33%. This confirmed enrolment in science club activities is skewed towards male students in secondary school. This is unsurprising considering the government's unrelenting efforts to ensure equity and equality in science and technology. The low enrolment of girls in SCA agreed with a study on determinants of girls low enrolment in Physics in Secondary in Kajiado North Sub- County, Kenya by (Mwangi, Gongera & Thinguri , 2013). The study revealed an alarming low number of girls enrolled in physics in the Sub-county as compared to enrolment in Biology and Chemistry which had large numbers of students.

Table 2: Gender, teaching experience, number per category and percentage of teachers

Gender	Number	Teaching Experience	Number (N)	Percentage
Male	48	0 – 4 yrs	10	19%
Female	5	4 – 10 yrs	28	49%
		10 – 20 yrs	15	28%
		20 or more	2	4%

Majority of teachers in the study were male at 91 percent while 10 percent were female. This further confirmed Physics is a subject dominated by male in Vihiga County. More than 80 percent of the teachers had more than four years of teaching experience and about 5 percent had worked for more than twenty years. This indicated teachers sampled had been in the profession long enough and had expertise to explain the values of SCA in learning and teaching of Physics.

Science Club Activities (SCA) and Physics teaching

Table 3: Analysis of teachers reasons for involving students in SCA

Statement	SD	D	U	A	SA
The SCA improve students' interest and motivation to learn Physics	0%	2%	4%	38%	57%
The SCA inspire students to chose Physics careers in future	0%	0%	6%	38%	57%
The SCA improve students' perception about the role of Physics and scientists in the society	0%	0%	13%	34%	53%
The SCA broaden students' view of Physics concepts and principles	0%	4%	13%	34%	49%
The SCA are relevant to class work,	4%	2%	4%	59%	32%
The SCA are teaching tools,	2%	6%	6%	55%	32%
The SCA enable students to travel to far places	28%	34%	13%	17%	8%
The SCA enable students to compete for certificates and prizes	30%	45%	13%	8%	4%
The SCA keep students busy in school	26%	51%	4%	11%	8%

From Table 3, nearly 90 percent of the teacher indicated that SCA improved students' interest and motivation to learn Physics while six percent did not agree. This indicated a majority of teachers highly regard SCA as materials for teaching Physics in schools. Over 95 percent of the teachers agreed that SCA inspired learner's career choices while 85 percent indicated the activities improved students' perception about the role of Physics and scientists in the society. This could be attributed to the fact that the SCA enabled students engage in what Physicists do and in turn inspired students to join Physics careers after school.

Table 3, further shows more than 80 percent of the teachers observed SCA broaden students' view of Physics concepts and principles. Equally over eighty percent of the teachers agreed SCA are relevant to class work and are teaching tools. The SCA were also highly rated by the teachers to provide link between classroom theoretical approaches and practical approach used in the industry. Table 3, still reveals that more than seventy five percent of the teachers disagreed students participated in SCA as away to travel to far places, to compete for trophies and certificates as well as keep students busy in school. The teachers'

position indicated though travel and competitions are part of SCA the overriding goal of the activities is learning.

Teacher Interview

Science Club Patrons interviewed indicated that science club activities (SCA):

-Stimulated individual input in science and prompted greater motivation and interest,

-Learners obtained feedback from multiple perspectives on science concepts during discussions.

-Offered opportunity for peer instruction and lead to formation of groups which worked on science congress competition projects.

-Provided forum to provoke controversy and debate on science issues and occasionally informed conclusions across all secondary school levels.

-Encouraged problem solving by using actual incidents that involve real situations.

-By designing and developing projects, students developed critical thinking skills and discover scientific concepts.

The results are supported by Bashir and Hussain (2012) who found that non-formal science in general influence student learning and performance. Also, in support is a study by Eastwell and Rennie (2002) who found a strong positive relationship between students' interest and their motivation with participation in non-formal activities. The researchers noted, students who participated in non-formal activities had high awareness and value of scientists and science to the society. Oriachi (2009) concurred with a study in Nigeria which found that students' motivation had a high positive correlation with academic performance and is necessary for better output in academic pursuit. In a similar study, Awodun, Oni & Aladejana (2014) revealed that students' attitude and interest in Physics is a better predictor of students' performance in Physics. However, Awodun etal(2014) noted student gender had no influence on students academic performance (is a poor predictor). By promoting interest and motivation towards Physics, achievement can be realized in Physics (Mbugua, Kibet, Muthaa & Nkonke, 2012).

The teachers' views that SCA prompt motivation and interest in learners are consistent with those of (Ng and Nguyen, 2006). The researchers found that SCA and real life contexts make Physics more relevant and improve students' conceptualization and understanding of phenomena.

Achievement students' in Physics Achievement Test (PAT)

Table 4 represents participants and non-participants of SCA had equal performance on Physics Achievement Test (PAT). The average score on PAT was thirty (30) marks. The results reveal that performance on PAT was below average for all the students sampled for the study.

Table 4: Achievement of participants and non-participant on Physics Achievement (PAT)

NFA	Variable	Participants	Non-participants
Science Club	Number	148	69
	Mean	18.82	18.20
	Median	18.50	18.50

From the Table 4, it can be noted that participants of SCA were twice non-participants but still registered a slightly higher mean score on PAT of 18.52 as compared to 18.20 for non-participants. The median for participants of SCA was equal that of non-participants. The study revealed that overall performance was below average on PAT, however, participants of science club activities slightly out performed non-participants. It can be inferred that increased exposure of students to SCA could translate to improved academic performance.

Table 5 below displays analysis of interest statements and corresponding means and medians for participants and non-participants.

Table 5: Analysis of perception of Participants and Non-participants about usefulness of SCA

Statement	Participants		Non-participants	
	Mean	Median	Mean	Median
Science club activities have helped me to improve my marks in Physics	4.16	4.00	2.72	3.00
Class work has helped me to improve my marks in Physics	4.52	5.00	4.58	5.00
Science club has improved my interest to learn Physics	4.27	4.00	2.91	3.00
Class work has improved my interest to learn Physics	4.31	4.00	4.53	5.00
I like Physics when we learn in class	3.88	4.00	4.17	4.00
I like Physics when I participate in science club	4.07	4.00	3.01	3.00
I feel like a Physicist when I participate in science club activities	4.37	5.00	3.06	3.00
I feel like a Physicist when I learn Physics in the classroom or laboratory	4.09	4.00	4.39	5.00
I understand the nature of Physics by participating in science club(how Physics and Physics)	3.97	4.00	3.04	3.00

I understand the nature of Physics by doing class work(how Physics and Physicist work)	3.85	4.00	4.22	4.00
All Physics lessons should incorporate more classroom work	3.06	3.00	3.65	4.00
All Physics lessons should incorporate more science club activities.	3.66	4.00	3.17	3.00
I am more likely to hand in Physics assignments when they involve science club activities	3.47	4.00	3.03	3.00
I am more likely to hand in Physics assignments when they are assigned in the classroom.	3.78	4.00	4.01	4.00

Table 5 shows participants of SCA had highest mean of 4.16 on the statement SCA- has helped me to improve my marks in Physics while the non-participants had a lower mean of 2.72. Table 5, shows non-participants of SCA had highest mean of 4.58 on the statement-class work helped me to improve my marks in Physics, however, the participants of SCA recorded a slightly lower mean of 4.53 on the same statement. This suggests that though SCA are occasionally undertaken in school, participants rated them as contributing to their marks in Physics as well. Table 5, further revealed that participants of SCA highly rated club activities as influencing their interest in the subject at mean of 4.27 as compared to non-participants with mean of 2.91. Both the participants and non-participants had higher means of 4.31 and 4.53 respectively on the statement-class work improved interest to learn Physics. This generally indicates that SCA contribute to Physics teaching and learning just as class work and laboratory which are convectional approaches for teaching Physics in school.

Table 6: Analysis of correlation between PAT and SMQ for Participants and Non-participants on PAT and SMQ

Variable	**Participants**		**Non-participants**	
	PAT-Participants	SMQ-Participants	PAT-non participants	SMQ-non participants
Number	148	148	69	69
Mean	18.54	53.89	18.12	48.76
StdDev	7.44	6.96	7.45	9.04
PAT-participants	1	.462*		
SMQ-participants	.462*	1		
PAT-non participants			1	.379*
SMQ-non participants			.379*	1

*Correlation is significant at the 0.05 level (1-tailed).

Scores on PAT and SMQ for participants (148) and non-participants (69) were used to run a Pearson moment correlation. Table 6 shows that participants had higher mean score on Student Motivation Questionnaire (M = 53.89) than that of non-participants which stood at (M = 48.76). Though participants and non-participants mean scores PAT were almost the same, the participants mean 18.544 was higher than that of non-participants by positive of 0.421 which is significant. The highest variation in mean was recorded for non-participants on SMQ scores (M=48.76, SD = 9.0436) and the least variation was recorded for participants on SMQ scores (M=53.893, SD = 6.960). Overall, it is observed that the participants of SCA out performed non-participants on both instruments (M= 18.544, SD = 7.437; M = 53.893, SD = 6.960). Furthermore, Pearson correlation coefficient for participants ($r(160) = .462$, $p<.05$) and non-participants ($r(66) = .379$) reveal that PAT performance is positively influenced by involvement in science club activities (SCA). This therefore signifies that student interest in science club Activities (SCA) positively influence performance in Physics subject

These results corroborate with Adeyemo (2010) who observed that school based non-formal activities have significant influence on students' achievement in Physics. According to the researcher non-formal activities provide varied opportunities for learning, teaching, social interaction, physical and cognitive development of learners. Thus every child in school should be given a chance to participate in at least one non formal activity that suits his or her personal interest. The findings also agree with Marsh and Kleitiman (2002) who noted that students who participate in non-formal activities achieve better than non-participants. The researcher observed that non-formal activities have proven benefits in building and strengthening academic achievement, regardless of their relation to academic subjects. Further the results concurred with (Moriana, Alos, Alcala,Pino,Herruzo & Ruiz, 2006) who found that students involved in activities outside the school day had better academic performance, especially for those who participated in study related activities.

V. CONCLUSION

Based on the finding, it can be concluded that science club activities (SCA) effectively and supplement convectional teaching methods of teaching Physics in secondary schools. The results showed that participants of the science club activities (SCA) slightly outperformed non-participants on Physics Achievement Test (PAT). The efficacy of science club activities

(SCA) can be attributed to the fact they encouraged direct interaction between students on concepts of interest and hence allow multiple approaches to learning. The learning emanates from discussion, research, presentations and open inquiry which are practiced by learners and are active methods or child centre approaches to learning. Science club activities (SCA) also provided learners with room of interpersonal communication and collaboration skills as they are exposed learners to team-based problem solving especially when working on science congress projects.

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