

Experimental Approach as a Methodology in Teaching Physics in Secondary Schools

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Abstract

Use of experiment as a teaching methodology for Physics in secondary school is crucial for successful concept delivery by the subject teachers and concept mastery by the learners. Delivering quality content in Physics in most schools in Kenya, nevertheless, has been met with a number of challenges such as inadequate trained teachers, lack of infrastructure (for instance, Physics laboratory, laboratory apparatus, and lack of Laboratory Assistants etc. For instance, in 2014 Gem District (in Kenya) 52% of teachers of Physics are untrained (that is, they lack basic training to qualify them as teachers of Physics). The contribution of this study is to establish the influence of teacher-based factors on the use of experiments in teaching Physics in secondary schools in Kenya (case of schools in Gem District). Specifically, the study addresses the following objectives: firstly, it determines the influence of the teacher's professional qualification on the use experiments in teaching Physics; secondly, it establishes the influence of teacher experience on the use of experiments in teaching Physics and the influence of teaching load on the use of experiments in teaching Physics; and lastly, it establishes the influence of the lesson preparation on the use of experiments in teaching Physics. The study employs both descriptive survey and correlation design approaches with a population of 32 participants. Data is collected using questionnaires and interviews. A pilot study is done in 3 secondary schools to test the reliability of the data instruments (achieving Pearson's r value of 80%) We use both descriptive and inferential statistics such as mean, percentages frequencies and Pearson's r to analyse the quantitative data while qualitative data is transcribed, organized and categorized according to themes and sub-themes. The study results shows that teaching experience, teacher's preparation, lesson planning and teaching load affect the quantity and quality of experiments carried out by Physics teachers.

Keywords: Physics education, Physics experiments, Physic teaching, Lesson preparation.

1. Introduction

The teaching of Physics using experiments as teaching aids emphasises procedural aspects of knowledge acquisition based on the investigative nature of conceptualization and on observation as a source of knowledge. Combining different types of experiments easily guide students to differentiate between observational evidence and observational inferences Etkina (2002). As noted by McDermott, Shaffer &Constantinou (2000), experiments are the basis and source of new knowledge and if well interpreted, they can be used to establish new theories, disapprove theories or re-define theories. This implies that to improve the teaching of Physics, experimental approach should be emphasized to promote the learners' understanding of concepts. Specifically, this enables students to develop skills to infer and interrelate with multiple concepts, for example, the domain of objects, observable properties, and events in one hand to domain of ideas (knowledge) on the other (Millar et al., 2002). Demonstrations and practical laboratory sessions has long been accepted as an integral part of the learning and teaching of Physics and it would be only impractical to teach Physics without experiments (Abrahams, 2005).

Teaching approach that a teacher adopts directly affects students' achievement. For instance, most teachers of science and mathematics in Kenya had adopted lecturing approach to teach in secondary schools leading to poor mastery of the subject content matter. Complementary in-service training for mathematics and science teachers has since been introduced to widen instructors' teaching approaches (Mills, 1991, (JICA, 2001). The lecture approach of teaching had been attributed to teachers' heavy work load in schools considering that most schools have science teacher student ratio of 1:50 and only a few consider experiments (Ayem, 2010). In the midst of all these challenges the number of Physics teachers which has not been increased as most students' consider more lucratively paying jobs. As a matter of fact, teaching is gradually becoming a vocation rather than a profession as reported by Adeyemo (2010).

The only possible remedy to this for school head (based on restrictive fund allocation to schools by the government), is to employ unqualified Physics teachers to teach sciences particularly Physics. That is the current problem affecting schools in Gem District of Siaya County in Kenya (as shown in Table 1).

District	Number of schools	Number of Physics teachers	Trained Physics teachers	Percentages
Gem	32	56	27	48
Bondo	24	39	26	67
Ugenya	14	26	18	69
Siaya	26	48	30	62

Table 1: Percentage of TSC Teachers in Siaya County

(Siaya county CEMESTEA OFFICE-2011)

Based on Kenya Institute of Education (KIE 2002) Physics syllabus, all topics in Physics need to be taught using experiments apart from topics that fall under modern Physics (e.g., radioactivity, electromagnetic spectrum, x-rays, cathode rays and cathode ray tube). Particularly, the Kenya National Examination Council (KNEC) has been careful to test Physics in both theory and practical exams with the later contributing 40%. Specifically, KNEC ensures that the following three key topics in Physics contribute to at least 80% of Physic practical exams that is, measurement, magnetic effect of electric current and reflection at curved surfaces. In this study, we investigate the use of experiments in teaching these topics.

Physics as a science subject in secondary schools has a lot of contribution to students' career preparation particularly in engineering, medicine and pure science. Therefore, it is crucial that students are not only prepared to pass the final year Physics exams but that they are prepared for Physics related career choices and application of Physics in real life. This objective is not easily attainable considering in appropriate teaching approaches in most schools. As a matter of fact, 52% of teachers of Physics in Gem District in the said year were untrained and unqualified to teach the subject.

This study intends to establish the influence of teacher based factors in the use of experiments in teaching Physics in secondary schools in Gem District. Specifically, the objectives of this study are to: establish the influence of teacher professional qualification on the use of experiments in teaching Physics; establish the influence of teacher experience on the use of experiments in teaching Physics; and to establish the influence of teacher teaching load and lesson preparation on the use of experiment in teaching Physics.

2. RELATED WORK

2.1 Teacher Professional Qualification

Internal efficiency in education is influenced by qualifications of the teacher and the teaching style (Sachs 2003), normally, examination scores and cognitive tests are used to measure internal efficiency. Teachers are required to have a formal training in education as a profession, for instance, Diploma in Education or Degree in Education which gives the instructors an in-depth understanding on teaching pedagogy and student psychology (Goldhaber 1999). Heidi et al (2007) notes that students' learning of science directly depends on teachers having adequate knowledge of the subject matter. Teachers with more content knowledge are more likely to teach in ways that help students construct knowledge (Alonzo 2002). Such teachers interact with the learners intensively through question-answering and investigation-explanation approach. Therefore academic and professional qualification are important teacher characteristic in determining effective teaching (Ong'ele 2007). It would be essential to establish whether having knowledge in a subject necessarily translates to effective teaching (passing the knowledge to the learners). Moreover, to what extent does professional qualification improve the teaching strategy a teacher uses. Such issues are the basis of this study.

2.2 Teacher Experience

Teacher experience influence student's achievements and training improves the teacher's personality and helps to develop in the teacher a set of attitudes that govern professional development (Wobmann (2000.)). In a nutshell, teachers that have worked for a long time have strong instructional skills and are capable of raising students' achievements. They are characterised with quickness in restoring order and developing a tempo of teaching which fosters more time on the tasks on the part of the students (Anderson, 2002). Brookfield (2006) and Richet (2000) on the other hand argues that prolonged practice of a profession does not guarantee any improvement in competence and are therefore, significant or insignificant to an individual depending on what one has acquired earlier and how one approaches the new learning situations.

Agwanda (2002) indicates that the lower the number of experienced teachers in a school the lower the level of students performance while Ong'ele (2007) illustrates that teachers with more teaching experience performed better in actual teaching than those with less teaching experience. This is similar to Sheerens (2000) that shows that poor performance in sciences in private schools is due to inexperienced teachers. The study is, however, silent on how teaching experience influences the use of experiment in teaching. The baseline studies established that most young teachers seemed to have problems in passing the content objectives to the students while experience teachers are complacent and tend to go to Physics laboratories unprepared and most likely repeat previous mistakes all the time as a number lack scheme of work and lesson plan.

2.3 In-Service Attendance of Teachers

Teaching and learning of science, has been a subject of debate for a long time with reference to the content of the curriculum and the teaching approach. To enhance the use of experiments, the South African government, came up with a number of initiatives and programs at national and provincial level; a typical example of which is the setting up of DINALEDI schools (Western Cape Department of Education, 2005). The DINALEDI project was a national initiative to improve the strategy for teaching science, mathematics and technology. The programme however, did not indicate how the use of experiments had improved. In Kenya there are programmes geared at strengthening mathematics and science in secondary education (SMASSE), which are basically focused on upgrading the ability of students in mathematics and science through a regular in-service course for teachers of mathematics and sciences (JICA, 2001). In-service training on the other hand makes the teachers professionals and enhances their performance (JICA, 2002). In- service training improves teachers' general educational background and provides them with the knowledge and skills linked to the ever changing needs of the dynamic society (Creed & Robinson, 2002). With improvisation; SMASSE (2003) indicates that numerous meaningful and focused activities can be organized for the students. Improvisation involves use of non-conventional materials conventionally. It may also mean that the use of materials in the environment in order to raise the students' interest and curiosity in addition to helping the learners relate the concepts learnt to the occurrence in day-to-day life. Low-cost materials produced through improvisation are not an attempt to provide a watered down science education rather a low cost and highly creative and productive learning process.

This in turn provides opportunities for creativity and development of manipulative abilities of the students and the concepts that are learnt, and internalized by use of concrete and speculative work as opposed to proceeding with chalk and teacher talk in the teaching of science (Pimpro, 2005). Improvised laboratory experimentation (ILE), for example, has been used as a remedy to the situation where there are inadequate teaching resources (Ndirangu, Kathuri and Mungai, 2003). Improvisation creates awareness of the unlimited opportunities that exist in seeking and using locally available materials.

Planning tools according to SMASSE (2003) such as lesson plans and schemes of work are not being prepared (and when prepared, then they are for presentation to the school inspectors rather than being used by the teachers) To assist the teachers in their planning, SMASSE advocates for activity-focused, students – centered learning with experiment and improvisation (ASEI) lesson plan, where the lesson notes are merged with plan of activities. Within this context, the use of experiments can be enhanced through virtual experimentation especially in cases where highly sophisticated equipment are involved. Kahere (2011) observed that science teachers who had gone for the four SMASSE-Insets had positive attitude towards experiments, confidence and were able to improvise in cases where resources are not available. The post professional programme also supports innovation or test of new curriculum, methods and materials for instructions. UNESCO (2006) indicates that the sole reason for training and continuous training of teachers is to improve the overall quality and depends on the relevance of curriculum, methods used, text books and other teaching facilities and equipment employed. The four SMASSE- insets address different issues based on teaching resources and the use of

experiments. Notably, in-service training leads to improvisation of learning materials and enhance the use of experiments. However, the influence of in-service attendance on the use of experiments in teaching Physics, that is, whether Physics teachers have improved or diminished the use of experiments is yet an open subject for study. We, therefore, explore this objective.

2.4 Teaching Load

Heavy teaching load is as a result of high rate of teachers turnover and natural attrition. In the US, there are significant effects of school characteristics and organizational conditions on teacher turnover (Ingersoll, 2001). In China, the recent opening-up of labor markets, in general and within the school system, has raised concerns about retaining qualified teachers in schools serving poor communities (Sargent,2003).In South Africa, concerns about teachers' heavy teaching load and especially in sciences are beginning to be articulated strongly. In a speech before parliament to support World Teachers' Day, the then Minister for Education, passionately urged students to study to become teachers, allaying fears of retrenchments and further instability in respect of appointments following the termination of the agreement of rationalization and redeployment (Xaba, 2003).

In most African countries, the phenomenon of teacher turnover is associated mainly with the HIV/AIDS epidemic, especially in Sub-Saharan countries like Zambia, Kenya, Nigeria, the Central African Republic and South Africa (Coombe, 2002). In some countries, for instance, Gambia, massive exit of teachers from the profession is due to uncompetitive salary schemes, allowances and promotion (Xaba, 2003). In Kenya, the government continues to encourage construction of new secondary schools to cater for the rising number of pupils who complete primary education. More teachers are required to teach in these secondary schools. It is important, therefore to address the challenge of heavy teaching load experienced by Physics teachers more so in public secondary schools in Kenya. Wafubwa (1991) notes that mobility of science teachers from Kenyan secondary schools to other professions is a major cause of heavy teaching load in secondary schools.

Although free primary education introduced by the government in 2003 has increased pupils' enrolment in primary school, the initiative has exacerbated the problem of teaching resources (Otiato, 2009). Onyango (2001) observes that the limited number of Physics teachers in Kenya has led to heavy work load such that the teachers would not emphasize the need for practical lessons. This has compromised the use of experiments as teaching aids hence calls for employment of more Physics teachers (by TSC through the school board of management) to ease the teaching load. The TSC policy on the teaching load recommended for effective teaching and learning is summarized in the Table 2.

Table 2: Recommended T.S.C. load for teachers and Head teachers

Teachers	Maximum recommended load
Teachers	27
Head teachers	12

(T.S.C. Newsletter -2011)

According to the District Education Officer (DEO) Gem District, about 10 science teachers have left teaching for other jobs in the last 2 years in the District(as by July,2011) and the government only replaces teachers that have retired or left the profession due to natural attrition.

Table 3: Physics teachers teaching load (n=29)

Number of lessons per week	Frequency	Percentages
Above-36	1	3.45
28-36	21	72.41
19-27	4	13.79
10-18	3	10.35
Total	29	100.00

With regard to the TSC policy the teachers in Gem district has higher teaching load with comparison to the recommended number of lessons. We, therefore, establish the influence of teaching load on the use of experiments in teaching and learning of Physics in Gem District.

2.5 Level of Lesson Preparation

Lesson planning is a vital component of the teaching - learning process. According to Biggs (2000) teachers rely, for their planning, on the content and methods outlined in the text books, syllabus and teachers guide. On macro level, a lesson plan is a reflection of a philosophy of learning and teaching which is reflected in the methodology, the syllabus, the texts and the other course materials and finally results in specific lessons (Jensen, 2010). Moon (2005) asserts

that proper classroom planning will keep teachers organised and on track while teaching thus allowing them to teach more and help students achieve objectives more easily. This is in line with the fact that the better prepared the teacher is, the more likely she/he will be able to handle the unexpectedly happens in the lesson. Lesson planning provides a coherent framework for smooth efficient teaching and helps the teacher to be more organised and gives a sense of direction in relation to the syllabus (Scrivener,2011).In this regard, lesson preparation by the Physics teachers enable them carry out experiments (with the available physical resources). That is, we establish how lesson preparation by physics teachers influences the use of experiments in the teaching of Physics.

3.0 RESEARCH METHODOLOGY

This study uses both descriptive survey and correlation design. Descriptive survey is to get opinions, attitudes, knowledge and perception of teachers and head teachers on the extent to which Physics teaching resources influenced the use of experiments during Physics lessons. On the other hand correlation design is used to assess the degree of relationship that exist between teacher based factors, availability of laboratory assistants, Physics teaching resources and number of experiments conducted by the Physics teachers (Aldrich ,1995).

The topics focus being Physics teaching in form two. Saturated sampling is used to select 1 DQASO, 29 Head teachers and 29 Physics teachers totalling to 59 respondents.

Table 4: Sample Population

Category of respondents	Total population	Sample	Percentages
Physics teachers	32	29	90.63
Head teachers	32	29	90.63

3.1 Instruments for Data Collection

Data is collected using questionnaires and interview schedules. The research instruments are pre-tested in three schools in Gem district before they are apply in the actual research.

Validity and reliability.

Pre-testing ensured that the instruments are of acceptable reliability and validity. Validity of research instruments was ascertained by presenting them to three experts in the Faculty of Education for scrutiny and verification. Reliability is determined by the test–retest method for the internal consistency of the instrument. The instruments are administered twice to the same group within a fortnight between the first and second test. A comparison between the scores in the first and second test is made and a Pearson Product Formula is used to calculate correlation coefficient (r) in order to establish the extent to which the contents of the instruments are

consistent in eliciting the same response every time the instruments are administered. The values of r for questionnaires are calculated as 0.87, 0.94 and 0.85 for Physics teachers, head teacher. Orodho (2004) observes that $r > 0.8$ is good enough to judge instruments as reliable for study. The quantitative data collected from close-ended questions are analyzed and presented using descriptive statistics, that is, means, frequencies and percentages while inferential statistics are used to establish correlation coefficient which exist between the variables in the study. The correlation coefficient in this study represents the influence or the relationship between the variables being compared. Qualitative data collected from open-ended questions and interviews are transcribed, organized into categories, sub-categories and themes as they emerge from the field and analysed based on the research objectives.

RESULTS

4.1 Teacher Professional Qualification

Physics teachers who participated in the study were asked about their highest level of professional qualifications. A correlation between professional qualification and the number of experiments were then established. The results of the study were tabulated and summarised as shown in Table 5.

Table 5: Physics Teacher Professional Qualification (n= 29)

Professional qualification	Frequency	Percentage	R
M.Ed	1	3.40	0.623
BSc.with PGDE	2	6.90	0.546
Bed(Science)	13	44.80	0.640
Dip.Ed	4	13.80	0.520
Untrained	9	31.00	0.500
Total	29	100.00	

**Correlation is significant at the 0.01 level (2-tailed)

The results indicate that 31.10% of the teachers have not undergone any professional teacher training course on the use of experiments in teaching and hence they may not appreciate their importance. Table 5 reveals that there exists a statically significant relationship at 0.01 level, with teachers with Bachelor's Degree in Education having the highest correlation coefficient $r=0.640$. The positive relationship here implies that the trained teachers carry out more

experiments in the topic in question than the untrained teachers. The study indicates that masters degree does not add more value as to encourage teachers to enhance the use of experiments. It is important for the schools in the district to employ professionally qualified Physics teachers who understand and appreciate the role of experiments in teaching and learning of Physics.

4.2 Teaching Experience

Table 6 shows the data that was collected based on the teaching experience of Physics teachers in Gem District. A correlation coefficient was established between the number of years of teaching (teachers' experience) and the number of experiments carried out during a specified time.

Table 6: Physics Teachers Teaching Experience (n=29)

Length of Service(years)	Frequency	Percentages	R
Between 0-2	16	55.17	0.623
Between 2-4	7	24.13	0.756
Between 4-6	4	13.80	0.711
Over 6 years	2	6.90	0.873
Total	29	100.00	

**Correlation is significant at the 0.01 level (2-tailed)

In the present study, a teacher who has taught Physics for above two years and above is considered as being experienced while one who has taught for less than two years is considered as inexperienced. This is so because, according to section six of the Teachers' Service Commission (T.S.C) Regulations (Act 1966, No.2 of 1967) which states that a teacher is employed and only confirmed on permanent and pensionable terms after completing the mandatory two years probation. Only 44.84% of the teachers has a teaching experience of above two years. The two tailed Pearson correlation coefficient (significant at the 0.01 level) shown on Table 1.5 give a value of $r=0.873$ for the most experience teachers. The use of experiments in teaching Physics thus is strongly influenced by the teaching experience. Besides, a teacher who had been teaching Physics for a long period has a better chance of improvising hands on activities during the process of teaching (Anderson, 2002). Myers (2008) asserts that turning to personal experience or to that of others is a useful method of obtaining knowledge, but uncritical use of the same may lead to incorrect conclusions. To him one of the most fruitful sources of problems for the beginning teacher is his own in-experience as a professional educator.

Experienced teachers know that successful teaching depends on the application of rigorous principles and skills to the task of preparation and presentation of teaching materials that are needed for carrying out experiments during a given Physics lesson. Adeyemi (2008) in a study on teachers teaching experience and students learning outcomes in secondary schools concluded that teaching experience is a critical variable. In formulating better strategies to apply at any given situation and better ways of bringing the subject matter to students.

Ong'ele (2007) also supports the argument that those with longer teaching experience perform better in actual teaching than those with less teaching experience

4.3 Physics Teachers Teaching Load

The study notes that, Physics teachers also teach other subjects such as Mathematics and Chemistry. The Physics teachers teaching load and a correlation coefficient r between the teaching load and the number of experiments carried out are shown in Table 7

Table 7: Physics teachers teaching load (n=29)

Number of lessons per week	Frequency	Percentages	R
Above-36	1	3.45	-0.687
28-36	21	72.41	-0.664
19-27	4	13.79	-0.693
10-18	3	10.35	-0.750
Total	29	100.00	

**Correlation is significant at the 0.01 level (2-tailed)

Table 7 reveals that 72.41% of the teachers have lessons ranging from between 28 to 36 per week while 3.45% of the teachers have a work load of above 36 lessons per week. The numbers of lessons teachers handle affect their preparedness for each class and between classes daily. This influences the use of experiments in teaching Physics. The Pearson $r = -.750$ for teacher with few number of lessons, which implies that there is a strong negative relationship between teaching load and the number of experiments Physics teachers carry out. Teaching load therefore influences the use of experiment in the teaching of Physics and this can be attributed to the fact that teachers with more lessons perform fewer experiments as compared to their colleagues with fewer lessons teachers have a teaching load of 28-36. The study observes that 75.86% (22) of Physics teachers who participated in the study have a teaching load of above 27 lessons a week, which is contrary to the TSC recommendation. The implication of the results in

Table 1.6 is that most of the Physics teachers in the district experience heavy teaching loads. The use of experiments in the teaching of Physics necessitates that prior preparation before execution of the lesson is an obligation thus, a heavy teaching load will negatively influence the use of experiment in the teaching of Physics due to lack of adequate time for preparation. It is for this reason for example, that Physics teachers in this situation at times may resolve to use the lecture method. The new Physics syllabus dictates that teachers employ practical approach in teaching the subject. This can only be achieved when the teaching load that teachers have give them ample time to prepare the teaching resources for use before the beginning of each lesson.

4.4 In-service attendance by Physics teachers

The study seeks to find out from Physics teachers the in-service trainings attended and how it enhances the use of experiments in the teaching and learning of Physics. It is worth observing that the main in-service programme for Physics teachers was SMASSE. Table 8 shows SMASSE attendance by teachers in the district.

Table 8: Physics Teachers SMASSE Attendance (n =29).

Number of Cycles attended	Trained teachers	Untrained teachers	Total Frequency	Percentage	R
0	7	3	10	34.48	0.300
1	3	4	7	24.14	0.281
2	3	2	5	17.24	0.301
3	3	1	4	13.80	0.351
4	3	0	3	10.34	0.377
Totals	19	10	29	100.00	

**Correlation is significant at the 0.01 level (2-tailed)

The research reveals that 34.48% of the Physics teachers who took part in the study had not attended the SMASSE in-service training. This they attribute to them having been recently employed by either the TSC or BOG thus have not gotten a chance to participate in the training and only 10.34% of Physics teachers having attended four Cycles (4-cycles). Table 8 indicates that there is a positive relationship between the number of experiments and the number of in-service training sessions attended with the highest correlation coefficient of $r=0.377$ being established. Other factors held constant, the relationship is statistically significant at 0.01 levels.

Table 9: Availability of Professional Materials (n=29)

Response	Frequency	Percentage	r
Schemes of work	26	89.66	0.752
Lesson plan	1	3.45	0.950
Records of work	20	68.97	0.773

**Correlation is significant at the 0.01 level (2-tailed)

In this particular study $r \leq 0.5$, an indicator that most of the Physics teachers have not attended the minimum number of Cycles (4-cycles) recommended. The study therefore observes that, in-service training strongly enhances the use of experiments in teaching Physics. This therefore implies that if majority of Physics teachers would have attended the 4-Cycles then $r \geq 0.5$.

Different SMASSE-INSET Cycles address different pedagogical skills and the SMASSE concept is meant for lesson improvement by making the lessons more students centred. It is therefore unfortunate to observe that only 10.34% of the Physics teachers had attended the four basic cycles. This is compounded by the fact that missing a cycle results in incoherence by the Physics teacher in the implementation of certain learning approaches and manipulative skills to the learners.

SMASSE has been one of the in-service programmes that have been emphasized by the Ministry of Education. The study observed that there is a need to train more Physics teachers, and schools should be encouraged to employ trained Physics teachers as it is only appropriate and more meaningful that one should attend post service training after a pre-service training.

The study observes that in-service training encourages teachers to: enhance students' centred learning and lesson observation skills; facilitate outside classroom relations; helps to give learners tips on how to answer exam questions and give ideas in conducting practical lessons to students. Perraton, Creed and Robinson (2002) assert that in-service training improves teachers' general educational background and provides knowledge and skills linked to the ever changing needs of the dynamic society. A post professional programme given to teachers during their period of employment is very crucial in a teacher's professional development because it helps to fill in the gaps left by college training. This view is also held by UNESCO (2006) which proposed that, the sole reason for training and further training of teachers is to improve the overall quality which depends on the relevance of curriculum, methods, text books and other teaching and learning resources employed.

4.5 Level of Lesson Preparation

To establish how well Physics teachers prepare for their lessons, they are asked to respond to questions dealing with preparation and availability of professional documents. On the availability of professional documents Physics teachers' responses are summarised as shown in the table.

The study observes that 89.66% Physics teachers have schemes of work in place while 68.97% of them have record of work covered book in place. The study further established that only 3.45% the Physics teachers who participated in the study have lesson plans in the course of instruction delivery. The fact that 10.34% of Physics teachers do not value the role of schemes of work, 96.55% did not see the value of a lesson plan and 31.03% do not have records of work within that particular period is a big concern. This may be attributed to lack of professional qualification needed for the use of these professional documents or lack of supervision by the head teachers. This would in turn influence their teaching of Physics which is an experiment oriented subject. The use of experiment in teaching requires prior planning and this explains the importance of schemes of work. Arguably, teaching without schemes of work is indeed tantamount to teaching and learning without any objective. This can also be a pointer to the existence of an inefficient administrative structure in these schools.

Table 9 reveals that those teachers that prepare lesson plans have the highest r value of 0.950, an indication that the relationship between number of experiments conducted and preparation of lesson plan is statistically significant at 0.01 coefficient level when other factors remain constant. The r value confirms that lesson preparation, especially lesson plans is one of the pillars for effective use of experiments in teaching Physics. The heads of departments are always assigned by the head teachers the duty of constantly checking the schemes of work and counter checking the work covered to ensure that schemes of work are utilized effectively. Schemes of work are important as they help the school administrators and Physics teachers to plan. When planning the teachers attend to four areas: goals, sources of information, the form of the plan and the criteria for the effectiveness of the planning. This is supported by Mutua and Namaswa (1992) who notes that planning is concerned with setting up a system for utilizing resources to their best advantage, which is, a good teacher is concerned with the optimum use of resources to meet, in the most economical way, the given educational aims. Planning therefore, is the first and crucial part of good educational management.

CONCLUSIONS

The analysis of the data shows that 68.90% of Physics teachers who participated in the study were professionally trained teachers. The study observes that 44.83% of the teachers had a teaching experience besides their professional qualification. However, majority of Physics teachers (55.17%) had a shorter teaching experience and this is reflected on the performance. It was observed that among the 65.52% of Physics teachers who had attended SMASSE- INSETs, only 10.34% of them had attended the four basic cycles while 34.48% of Physics teachers had

never attended any INSET. It was noted that the INSETS were rated relevant by majority all of the teachers who had attended the SMASSE-INSET. The study established a strong negative relationship between the teaching load and the number of experiments with a highest correlation of $r=0.750$. The correlation pointed out that those teachers with few lessons carry out more experiments than those with more lessons. When the number of experiments were correlated with availability of schemes of work the highest correlation coefficient established was $r =0.950$, an indication that the relationship between number of experiments conducted and preparation of schemes of work is statistically significant. The r value confirms that level of lesson preparation is one of the pillars for effective use of experiments in teaching Physics. In reference to professional qualification and teacher experience the highest correlation coefficient registered are of $r=0.640$ and $r= 0.873$ respectively. Based on the findings aforementioned, the study establish that, teacher experience, lesson preparation and teacher teaching load are the only teacher based factors that strongly influence the use of experiments.

FUTURE WORK

The study makes the following recommendations for further research.

- 1) A study on influence of teaching resources on the use of experiment in teaching of Chemistry and Biology should be undertaken within the District.
- 2) This study focuses mainly on the teacher based factors; a further study can be done on other teaching resources that influence the use of experiment as a classroom approach in teaching and learning of Physics.

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