

## An Exploration of Factors that Contribute to Low Performance in Physics: A Case of a Secondary School in Kenya

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**ABSTRACT:** The study reported in this paper aimed at exploring the factors that contribute to students' low performance in physics. Study participants were 2 physics teachers (a male and a female) and 57 physics students (30 males and 27 females) drawn from a coeducational, government day secondary school located in Embu County in Kenya. The study adopted a mixed method approach, whereby both qualitative and quantitative methods were utilized to gather data. Analysis of quantitative data was done using the SPSS software package while the qualitative data were analyzed manually using thematic content analysis.

Three major categories of factors were identified as contributing to students' low performance in physics; namely, learning factors, teaching factors, and administrative factors. Learning factors are those factors that emanate from the learners, such as time management skills and background in mathematics; teaching factors are those factors that are attributable to the teacher, such as quality of teacher-student interactions and teacher's content knowledge; while administrative factors are those factors that can be attributed to the administrative context within the school, such as access to resources and quality of guidance provision. Based on the research findings, a number of recommendations are made to practitioners and policy makers. For teacher educators, a proposal is made to include a course on improvisation in physics education during teacher pre-service training. For the school administrators, it is recommended that mechanisms be put in place to ensure that the students' voice is heard and supported during selection of preferred subject combinations. For teachers, it is recommended that the use of practical and interesting learning experiences during lessons be inculcated right from the first year of secondary education so as to engage the learners and sustain their attention.

**KEYWORDS:** Performance in physics; teaching factors; learning factors; administrative factors.

### 1 BACKGROUND

Physics – the branch of science concerned with the nature, structure and properties of matter – contributes enormously to the economy of any country. It plays a central role in many different sectors of industry such as telecommunications, architecture, engineering, electricity production and transmission, construction, and transport. It also provides employment for people who are in occupations that are engaged in physics as a scientific discipline – for example teachers, scholars, and other researchers. It is thus an indispensable part of any country's economic development. Furthermore, physics often provides the foundations for other disciplines such as biology, medicine and chemistry. It enables learners to develop analytical skills necessary for problem solving in various situations they encounter in life.

In Kenya, physics education will play a catalyzing role in the realization of Vision 2030, the country's national plan to become an industrialized nation by the year 2030 [12]. It is therefore important for Kenyan students to be well grounded in physics education to guarantee Kenya's economic development. In recognition of this, the Kenyan government in 1984 made physics a compulsory subject for all learners in the first two years of secondary education [7]. This move was aimed at ensuring that learners have a basis for understanding the applications of physics in real life situations. Despite the

government's effort, students have continued to register low performance in physics. The study reported in this paper sought to explore the factors that contribute to this state of affairs so as to enlighten the stakeholders in physics education on ways of improving the quality of physics education.

A review of the literature suggests that one of the key factors that affect students' performance in physics is student academic self-efficacy in physics [26]. The highly examination-oriented nature of the Kenya education system has not helped much. The pressure resulting from an over-emphasis on examinations makes students anxious and less confident about their competence in physics, thereby affecting their academic performance in this subject. A study carried out by Yousefi et al. [25] revealed that examination-related anxiety decreases students' learning capability, negatively affecting their academic performance. Furthermore, examination-related anxiety decreases motivation, which ultimately leads to academic failure [15].

A student's self-confidence in performing a variety of academic tasks has an effect on their academic achievement. A study conducted by Motlagh, Amrai, Yazdani, Abderahim and Souri [13] to investigate the relation between self-efficacy and academic achievement in high school students revealed that there was a significantly positive relationship between academic success and self-efficacy. In other words, students' academic achievement increases as their self-efficacy beliefs increase. Therefore, students who perform well in physics develop confidence in their physics capabilities translating to high grades in the subject.

When students enter high school they may encounter challenges related to adjustment to a new environment. For example, they may experience a change in the mode of responding to assessment tasks. If they do not receive the necessary support to adjust, they are likely to experience stress, which might make them experience difficulty in performing academic tasks. A study by Kumari and Gartia [9] revealed that there exists a positive relationship between stress and academic achievement. The authors concluded that students with high and moderate level of stress have higher academic achievement than students with low levels of stress. This is inconsistent with the results of another study by Emmanuel, Adom and Solomon [6], which showed that stress and academic performance are not always significantly correlated.

Student absenteeism is also detrimental to students' academic achievement. When students miss class, they miss the opportunity to access new curriculum content, ask questions, or generally participate in class activities, and those missed opportunities adversely affect learning. Students who attend all the classes post higher achievement scores than peers who miss classes now and then [18, 24].

Our analysis of the literature showed that very few studies have been carried out in Kenya to explore the factors that contribute to students' poor performance in physics. This study sought to fill this void by focusing on one purposively selected secondary school in Kenya. In the following section, a description of the methodology adopted in the study is described.

## **2 METHODOLOGY**

This study adopted mixed method design, whereby both qualitative and quantitative methods were utilized to gather and analyze the data. This was one way of increasing the overall validity of the study. Further, concurrent triangulation strategy was employed in which both the quantitative and qualitative data were collected at the same time and compared to determine if there was convergence, differences or some combination [5]. Quantitative data was collected using self administered questionnaires, while qualitative data was gathered through one-to-one semi-structured interviews and focus group discussions.

The interview involved ten students and two teachers. The sampling technique used was purposive sampling, whereby the two teachers were teaching physics, five students were studying physics and five students were not studying physics. The content of the students' semi-structured interview included: students views on student interactions, student teacher interactions, illustrations used and involvement during practical lessons among others. The teacher-participants were asked to share their views on the factors that contribute to students' low performance in physics.

A focus group discussion was also conducted with six students: two boys and four girls. In addition, questionnaires were administered to 41 students from among those who were taking physics students in form three and form four. The questionnaires had two sections. The first section sought the participants' demographic characteristics as well as their past performance in physics tests. In the second section of the questionnaire, the students were asked to indicate their perception on the factors that contribute to student's low performance in physics. These factors were presented using Likert-type closed-ended questions, whereby the participants were to indicate their agreement or otherwise of the factors using a five-point rating scale: 1-Strongly Agree (SA), 2-Agree (A), 3-Not sure (N), 4-Disagree (D), and 5-Strongly Disagree (SD).

## 2.1 DATA ANALYSIS

In this study, data analysis was done concurrently with data collection using an iterative analysis technique to ensure that the data already collected guided subsequent data collection [5]. For the quantitative data, the SPSS software package was used to analyze the data from the survey, which was used to generate charts and descriptive statistics. For the qualitative data, transcription of the audio-recorded data from interviews and focus group discussions was done, followed by reading and re-reading of the transcripts to identify the main ideas based on the similarities and differences in the data collected, and to compare the qualitative and quantitative data. During this process, the responses were coded based on the research questions. Codes were used to generate themes for answering the research question. The data analysis was done iteratively to ensure that the themes that emerged were saturated [20].

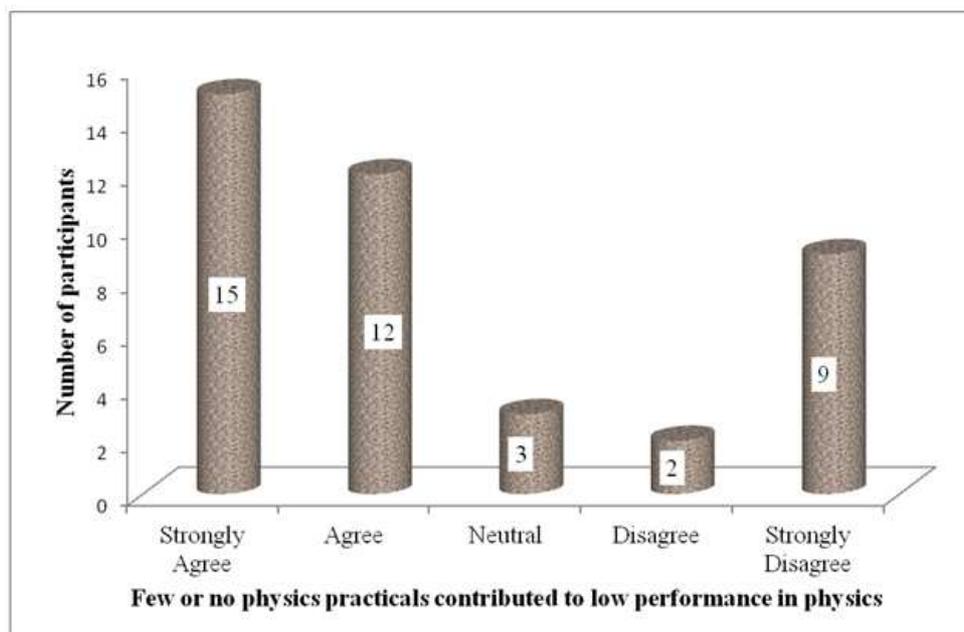
## 3 RESULTS

Our analysis identified three major categories of factors that contribute to low performance in physics: factors that emanate from the teacher; factors that emanate from the learners; and factors embedded in the context within which the school system operates. We termed these three categories as, teaching factors, learning factors, and administrative factors, respectively. Of the three categories, teaching factors emerged as the highest contributor to students' low performance in physics. In the following section, we discuss these three categories of factors in detail.

### 3.1 TEACHING FACTORS

As noted above, teaching factors refer to those factors that emanate from the teacher's personality and disposition, their style of teaching, their style of interaction with the learners, and their pedagogical content knowledge of physics.

Interviews with the students revealed that the students were taught physics in the laboratory through the lecture method. Some of the student-participants indicated that they had never had a physics practical lesson since they enrolled in the school. This situation disadvantaged students who appeared to be inclined to learn better through practical activities as one student-participant revealed during the interview by saying that, "if physics was taught practically all students would like the subject and get straight A's". Additionally, during the interviews with the teacher-participants, it emerged that the physics teachers were not incorporating practical activities in their teaching due to lack of enough time to prepare because of the huge workload. In the sampled school, there were only two teachers handling physics from form one to form four. Figure 1 shows that about 66% (27 out of 41) of the student-participants during the survey either agreed or strongly agreed with the attribution of low performance in physics to few or no practical physics lessons.



*Figure 1: Student-participants' agreement with the assertion that few or no physics practical lessons contributed to low performance in physics*

Apart from the non-use of practical activities in delivery of the physics lessons, the study revealed that the prevalent use of teacher-centered instructional methods was another factor that contributed to students’ low performance in physics. During the interviews and focus group discussions, the student-participants indicated that the teachers taught the lessons with minimal involvement of the students. The students remained passive throughout the better part of the lesson which made them lose concentration, with majority not understanding the physics content being delivered in the lesson. During the survey, majority participants agreed with the assertion that low performance in physics was as a result of physics lessons being boring, few or no practical lessons and poor teaching methods.

A good number of student-participants indicated that their physics teacher lacked physics subject mastery. For example, some students reported that when they asked questions during the lesson, the teacher would not answer right away. Instead, the teacher would promise to provide the answer in the next lesson, which he would never do. In addition, occasionally the students would request for clarification in the areas which were not clear to them during the physics lessons but instead of helping them, the teacher would ask the students to consult textbooks.

The two teacher-participants indicated that their preferred teaching subject was not physics and they were not comfortable teaching it. They indicated that they taught physics because they were the only teachers in the school who had taken physics as their second teaching subject during their pre-service training. Given a choice, the teachers indicated that they would opt to teach their first preferred subject.

The interview with the students revealed that during the physics lessons the teacher gave exercises and occasionally marked for the particular bright students and then continued with the lesson leaving the majority of the students’ work unmarked. Majority of the participants revealed that physics teachers were attending lessons late and failed to give remedial work to the weak students. According to the participants lack of teacher commitment led to low performance in physics in the internal and external assessments.

Some of the interviewed students reported that they did not like physics because their career aspirations did not require them to pursue physics. According to them, the only reason as to why they selected physics is because they wanted to escape from the biology teacher. The participants revealed that the biology teacher was very strict and occasionally gave students punishment due to incompleteness of biology assignments. The physics teacher on the other hand rarely gave students assignments and therefore never gave students punishments.

Figure 2 shows that about 68% of the participants in the survey indicated that physics teacher did not give remedial work to the weak students.

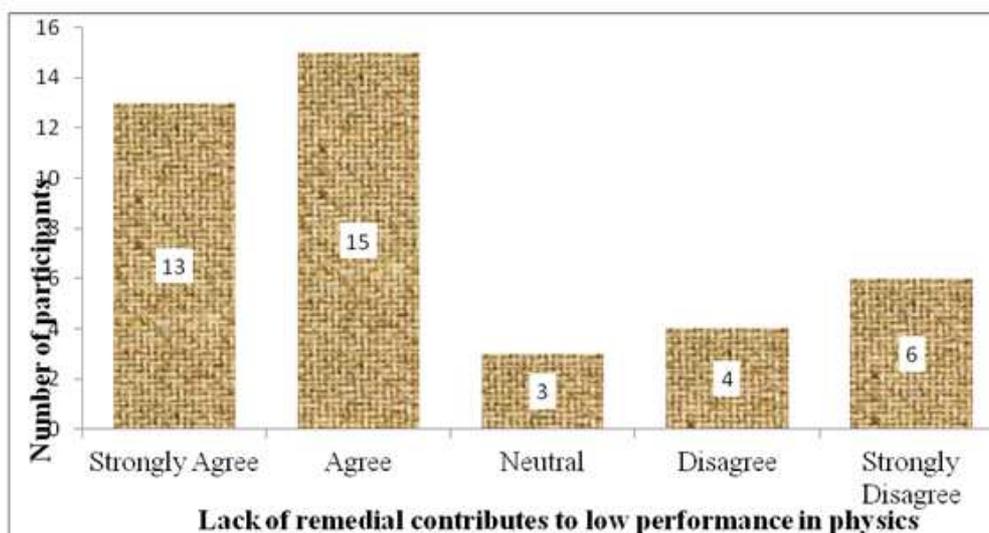


Figure 2: Student-participants' agreement with assertion that lack of remedial help to weak students was one of the factors which contributed to low performance in physics

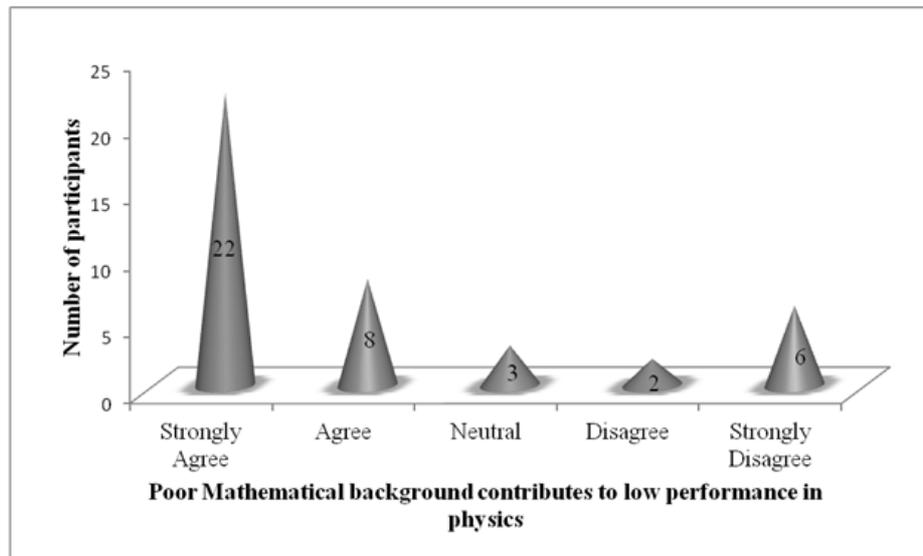
All the student-participants were in agreement that a teacher’s relation with his or her students plays a crucial role in students’ learning. If the teacher is unfriendly to students, they fear him/her and find it difficult to seek clarification of the concepts they have not understood during the lesson. Besides, from the interviews students liked teachers who were free

with them. An unfriendly teacher's disposition towards students can discourage the students from approaching the teacher for further guidance on areas they are having problems with in the physics syllabus.

### 3.2 LEARNING FACTORS

The data revealed a number of learning factors that contribute to low performance in physics. These factors are: student's background in mathematics, peer influence and student's time management.

Mathematics is extensively used in physics to communicate concepts. The study revealed that students with good mathematical background performed well in physics. Figure 3 shows that during the survey, about 73% of the participants indicated that poor performance in mathematics contributed to low performance in physics.

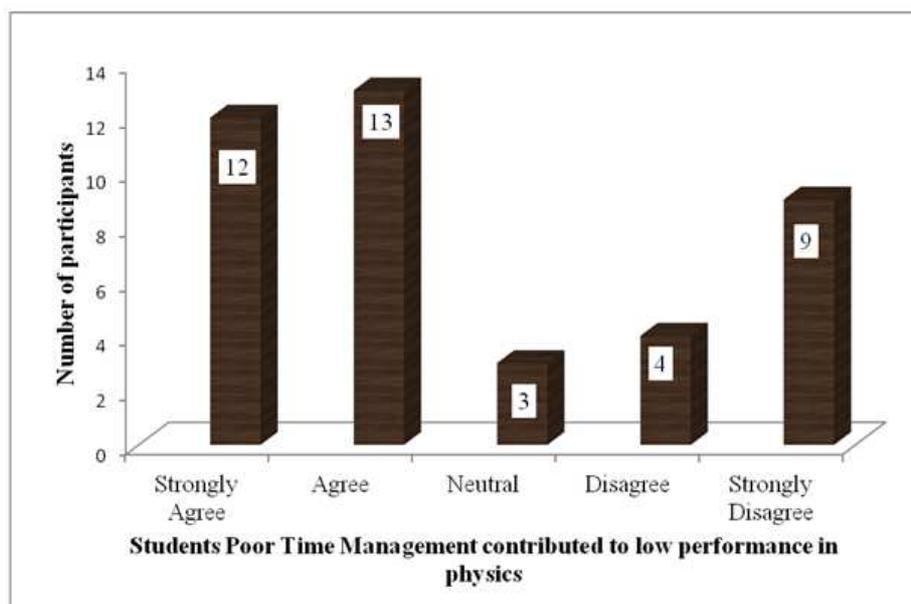


**Figure 3: Student-participants' agreement with the assertion that poor performance in mathematics was one of the factors contributing to low performance in physics**

Some of the students attributed their poor performance in physics to their poor mathematics background. Student-participants who had not selected to study physics in form three indicated that they had performed poorly in physics because of their poor mathematics background such that they had no idea on how to answer mathematical questions in physics examination.

Students spend a lot of time with peers and the discussion among the students becomes a major source of information concerning academic issues in the school. The study revealed that when new students join the school, they get most of the guidance from the senior students and whatever they are told they take it as the truth. It appears that students' low performance in physics was as a result of discouragement from the other students who never selected physics in form three. According to the student-participants, the senior students constantly reminded their junior peers that physics is generally hard and their performance cannot be like in other science subjects, and therefore they should not dream of performing well in the subject. This made the physics students comfortable with their low score in physics. Moreover, some students would discourage physics students from working hard by telling them that if they concentrate a lot in studying physics they will turn mad in future or become a social misfit. This is also in line with Adipo's [2] research findings that among the factors that affects students' performance in physics is negative influence from peers.

The data revealed that students' poor time management accounted to their low performance in physics. Figure 4 shows that about 61% of the participants in the survey indicated that students' poor time management was among the factors that contributed to their low performance in physics.



**Figure 4: Student-participants' agreement with the assertion that students' poor time management was one of the factors that contributed to low performance in physics.**

Time management requires the students to spend time in the most effective way to avoid spending more time in one subject than the other. During the focus group discussion it was revealed that majority of the students spend little time studying physics unlike other subjects. For example, Grace one of the student-participants said, "I have no time to read physics because at the same time I have assignments to write for other subjects. Either you do not work on the assignments and read or you work on the assignments and fail to read because one cannot do both because at the end of the day one will be very tired". Further, the study revealed that as the students wrote the assignments for other subjects they studied them but since they were rarely given physics assignments they rarely studied physics.

### 3.3 ADMINISTRATIVE FACTORS

Four administrative factors emerged from this study; namely, syllabus coverage, subject selection process, few physics teachers and inadequate provision of teaching/learning resources.

In the study, it came out strongly that failure to cover the physics syllabus was one of the factors that contributed to students' low performance in physics. The students attributed failure to cover the physics syllabus to frequent absenteeism by the physics teacher. The physics teacher had some health issues and the head teacher did not make arrangements to have another teacher step in those days the physics teacher was absent. During the interview one of the participants said, "the best student in end year 2013 physics examination attained 38%". This is because we had only covered three topics in form three physics syllabus. Being an external examination the questions were set from forms one to form three topics". Some of the students who were then in the first term of Form two had only covered six topics in form one syllabus because they had stayed for almost a term without a physics teacher.

All the form 3 students argued that their poor performance in physics was as a result of failure to complete the physics syllabus. According to them, they had learnt so little that they could not answer most of the questions in the end year 2013 physics examination.

In the study it emerged that students were not well guided on selection of subjects in form two, which probably contributed to low performance in physics. The student-participants revealed that the process was hurriedly done with some learners whose performance was above average in physics forced to proceed with it in form three. The participants argued that they were supposed to be well guided on subject selection process and the decision on which subjects to choose should be left to them. One student-participant said: "I do not know what I am doing in the physics class. I never selected physics. The selection was a flawed process". An interview with one of the teachers revealed that very few students select physics and, therefore, to increase the number, students who had comparatively good grades in physics were automatically included in the physics class. This implies that some of those students forced to be in physics might not be motivated to study the

subject resulting in low performance in physics. During the interview one of the teacher-participant said, "In the school we lack good guidance to the students on the subjects offered and their opportunities in life when students are in form one. This affects the choice of subjects by students in form three".

Lack of enough physics teachers also emerged as one of the factors that contribute to low performance in physics. The teacher-participants argued that they needed a manageable teaching load to be effective in their teaching; otherwise they had inadequate time for lesson preparation. They further argued that with more physics teachers in the physics department, they would be assisting each other through peer teaching, mentoring and team teaching.

While expressing concern about lack of teaching/learning resources in the school one teacher-participant remarked: "How do you expect student to attain good grades in physics when the school has only one laboratory which is not well equipped and there are other apparatus which cannot be bought because electricity has not been installed?" The teachers reported that they had only one type of physics textbook. They argued that they ought to have a variety of physics reference books for effective teaching. The student-participants also agreed with this. About 63% of the student-participants either agreed or strongly agreed that lack of physics textbooks contributed to their low performance in physics.

#### 4 DISCUSSION AND CONCLUSION

This study sought to explore that factors that contribute to students' poor performance in physics. Findings show that student-participants had expectations of their physics teacher with regards to establishing the classroom environment for effective learning. In particular, the students expected to be engaged during the lesson through practical activities and questioning. This is important because continually engaging students in the lesson would make them feel part of the knowledge generation community, which would get them motivated to learn physics. This is in agreement with Wellington [23] and Brooks [4], who argue that although practical work can sometimes be expensive and time consuming, it has simply to be done if the learners are to advance in their understanding.

Clearly, the student-participants expected that their teachers would mediate the textbook to help them understand physics in a better way. In line with the findings of Adipo [2], this study suggests that some physics teachers in Kenya lack subject mastery, which contributes to students' poor performance in physics. It is very difficult for the students to understand that which a teacher with poor content mastery is transmitting to them. Indeed according to Olabode and Olugbenga [17], a teacher's qualification level has impact on students' performance in physics.

The importance of teacher commitment to the teaching of physics cannot be overemphasized. As revealed in this study, lack of such commitment can only contribute to poor student performance. In line with the argument by Makewa, Role and Biego [10], results from this study indicate that low levels of teacher commitment translate into poor learner achievement. This is because the teacher should lead the learners in activities that promote learning. These activities include attending lessons punctually, giving and marking students' assessment tasks, and providing remedial help to struggling students.

Poor student-teacher interactions can hinder the attainment of good grades in physics as revealed in the study. As noted by Adeyemo [1], physics teachers can facilitate student learning by facilitating a co-operative and friendly atmosphere.

It is clear from the study that students' poor mathematical foundation is one of the factors that contributed to poor performance in physics. This is in line with findings of the study by Tuminaro and Redish [21] as well as that by Meltzer [11], which showed that a complete understanding of the concepts in physics requires fluency in the mathematical language in which these concepts are couched. This means that the physics teacher should support the students in both theory and mathematical aspects of physics. Sa'adatu [19] observes that good mathematics foundation facilitates students' ability to solve physics problems.

Peer influence has both positive and negative effects on a student's academic performance. The data from this study revealed negative effects of peer influence on student academic performance in physics. It is important to be aware those students are particularly vulnerable to all forms of peer influence which affects their academic achievement in school [8] and, as such, it is important for physics teachers to proactively find ways of combating negative peer influence.

It is clear from this study that there were some students' self-inhibiting behaviors which acted as a barrier to good academic performance in physics. These behaviors were lack of proper reading schedule and hanging out with friends during the time they were supposed to be having their private study. These behaviors made them lag behind in academic performance in physics. The situation was exacerbated by students having no assignments to work on during their free time. Therefore, having few or no assignments in physics prompted them to allocate little time for physics, resulted in poor performance in the subject. Therefore, there is need for teachers to guide students on proper study time management.

This study has also revealed that students' low performance in physics can be partly be ascribed to non-completion of the physics syllabus. Adequate and timely coverage of the syllabus builds confidence in learners resulting in improved performance. The confidence emanates from the fact that students get to know all the questions in the examinations are from the areas they have covered with the teacher. Besides, students who cover the syllabus in good time find adequate time for to revise for the examinations.

Evidenced in the findings of this study is the negative impact of the subject selection process in the school on the learners' performance in physics. As revealed during interviews there was a lack of professional guidance on subject selection in the school. This led to students selecting the subjects without being well informed, which in turn affected students' performance. In view of this, the school administration should devise ways and means of providing professional advice to students during the subject selection process, and giving students an opportunity to make their own independent choices. This would make students choose subjects in line with their career aspirations thereby motivating them to study the subject translating to good performance in the subject.

In line with the findings of Victoria [22] as well as those of Musasia, Abacha and Biyoyo [14], this study revealed that low enrollment and poor performance in physics can be linked to a shortage of inspirational and well trained physics teachers. Furthermore, this study revealed that a lack of adequate resource materials for the teaching and learning of physics contributed to poor performance in the subject. These findings are related to those of Nyamba and Mwajombe [16], which showed that lack of teaching/learning materials influences students' preference and performance in physics. According to Aina [3], the teaching of physics in schools has not been encouraging due to the abstract nature of the subject. As such, the use of instructional materials is essential in facilitating students' learning in physics. There is also a need for in-service professional development to empower teachers on improvisation of teaching-learning materials in physics, so that in contexts where there is inadequacy in teaching/learning resources, the teachers can be able to improvise.

#### **4.1 RECOMMENDATIONS**

Based on the findings of this research a number of recommendations can be made to improve students' performance in physics. To begin with, there is need to improve on teacher-student ratio so as to improve on the delivery of the physics curriculum. Having enough physics teachers will reduce the teaching load of physics teachers so that they have sufficient time to prepare for physics lessons consequently leading to improvement in the academic performance in physics.

In order for teachers to be well prepared to meet the challenges of teaching physics in a school with limited teaching /learning resources, it is important for student-teachers to receive pre-service training on teaching physics through improvisation. This can be achieved through, for example, the introduction of a course on improvisation in physics education. Additionally, teacher educators can organize for an in-service professional development course on improvisation in physics education for practicing physics teachers.

In the same vein, the school administration should work with physics teachers to minimize the problem of shortage of relevant teaching/learning resources in physics. This can be done through, for instance, procurement or borrowing some of the resources from such resource centers as SMASE centers or neighboring schools.

The school administration should also ensure that the subjects' selection exercise in form two is not only helpful to the students but also democratic. The students need to be well guided on how to make the right subject choices based on their career aspirations and personal interests.

The school administration should also ensure that the curriculum is implemented as intended by supervising the teachers to ensure that the intended curriculum is covered in good time.

Physics teachers should use practical activities in physics lessons to engage the learners and to sustain their attention. In addition, the use of student-centered pedagogies in physics classrooms should be the norm rather than an exception. Besides, the physics teachers need to have good student-teacher relationships where students are free to interact with teachers. During the interactions students open up on the challenges they face in academics and teachers get an opportunity to guide them on how to overcome those challenges

Finally, physics teachers should sensitize the students on the importance of physics in career choices as soon they are admitted in the school instead of learning from their peers who discourage them from studying physics. There is also need to motivate students to study physics by linking it to real life contexts so that they can see its relevance in their lives and in national development.

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