INTELLECTUAL ABILITIES PREDICTING STUDENTS' PERFORMANCE IN PHYSICS COURSES

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ABSTRACT

Students' continuous poor performance in Physics courses in tertiary institutions over the years has been a source of serious concern to all stakeholders in the educational sector. This study investigated three intellectual abilities viz: mathematical ability, spatial ability, and concept development as factors which predict students' performance in Physics courses. Using AkanuIbiam Federal Polytechnic, Unwana as a case study, the research findings revealed that despite the adequacy and availability of quality instructional materials, 53.3% of the studied population were below average (scored less than 40 marks) in terms of intellectual ability required to excel in Physics, even as teachers' outlook, commitment and approach to delivering Physics instructions were found to be reasonably high. The study recommends that aggressive guidance and counseling at secondary school level should be adopted, with greater emphasis on Physics education at that level so as to give students strong foundation on the subject. It also recommends that Physics teachers should improve on their instructional methods and approach in order to improve students' understanding and performance in the subject.

Keywords: Intellectual Abilities, Students, Performance, Physics.

INTRODUCTION

Physics education is an important part of the foundation for many technical occupations, and consequently, students' performance in Physics has been a subject of discussion and research globally (cf. Van Gorden and Slater, 1998; Farmer, 1993).

Science being the bedrock of technological breakthrough is regarded as the foundation for the development of any society, and as one of the branches of science, Physics performs very vital roles in the achievement of the goals of national development, but has been perceived as one of the most difficult subjects in the school curriculum (cf. Mustapha, 2002).

Physics is one of the physical sciences which is concerned mainly with matter in relation to energy and is very critical in the advancement of science and technology. The performance of the students in Physics, however, has remained poor, which is attributed to many factors including teachers approach. Other factors that contribute greatly to the poor performance of students in Physics in tertiary institutions are; students own interest, learner abilities, previous foundations, learning resources, and work load(cf. Owolabi, 2004).

Physics as a science subject is activity based and the suggested best teaching approach for the subject is a guided discovery method, which is resource-based. Although studiesindicate that college success for virtually all sciences and technical courses depend partly on good performance in Physics, developing countries face common problems in science performance(cf. Hart and Cottle, 1993; Alters, 1995).

This problem of poor performance in Physics is also partly due to rapid increases in students' population in schools, acute shortage in trained teachers, and lack of materials and facilities for effective teaching of science (cf. Comber and Keeves 1973).

According to reports by the Kenya National Education Commission, KNEC (2010), this underperformance of students in Physics may suggest students' inability to display:

i. Adequate knowledge, facts, principles, and laws that will help them understand the workings of Physics.
ii. Appropriate problem-solving skills in Physics to enable them cope with everyday problems.
iii. Ability to analyze common situations, make hypotheses, design and perform experiments to test their hypotheses, and come up with appropriate conclusions.
iv. Ability to make basic calculations required to solve standard Physics problems.
v. Appreciation of the importance of physics in society and its application in common everyday situation.
vi. Ability to recognize relationships between different variables in Physics.

In this study, three intellectual abilities viz: mathematical ability, spatial ability, and concept development were investigated using students from three departments of AkanuIbiam Federal Polytechnic, Unwana, Afikpo, Ebonyi State, Nigeria. The relationship between these intellectual abilities and students' performance in Physics is shown in figure 1 below.

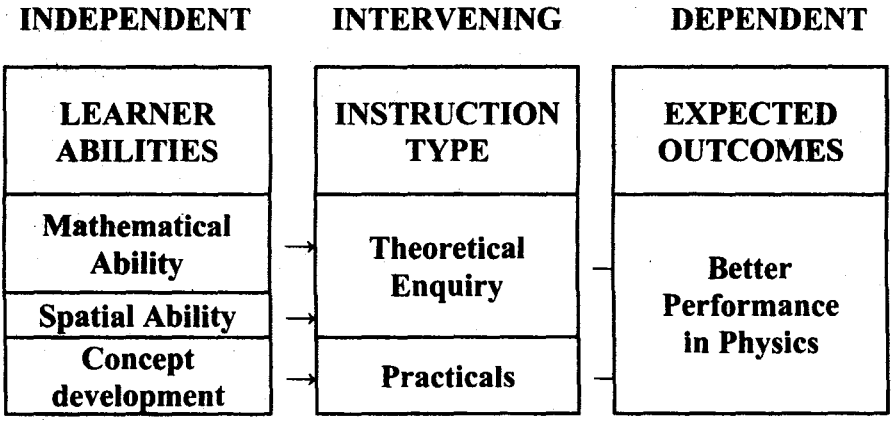

Fig 1: Relationship between Intellectual Abilities and Performance in Physics.

MATERIALS AND METHOD

The research was carried out using the descriptive survey design, involving the following events according to the sequence shown in figure 2 below:

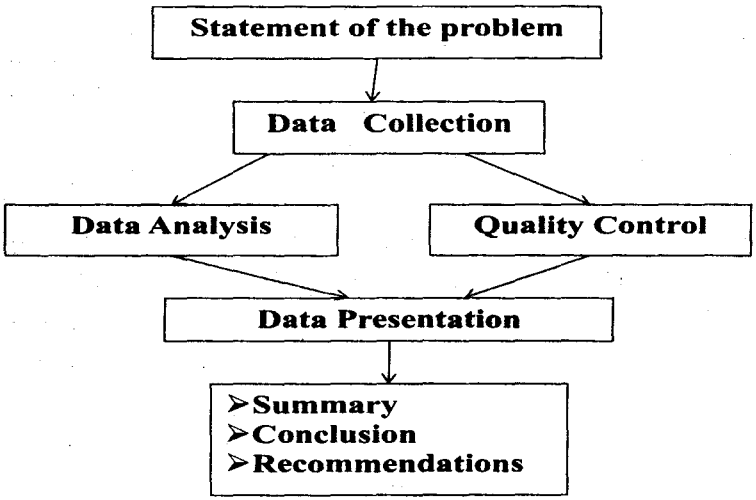

Fig 2: The Study Design and Process Flow Chart.

SAMPLING PROCEDURE

The sample size used for the study was selected through random sampling and its distribution is as shown in figure 3 below:

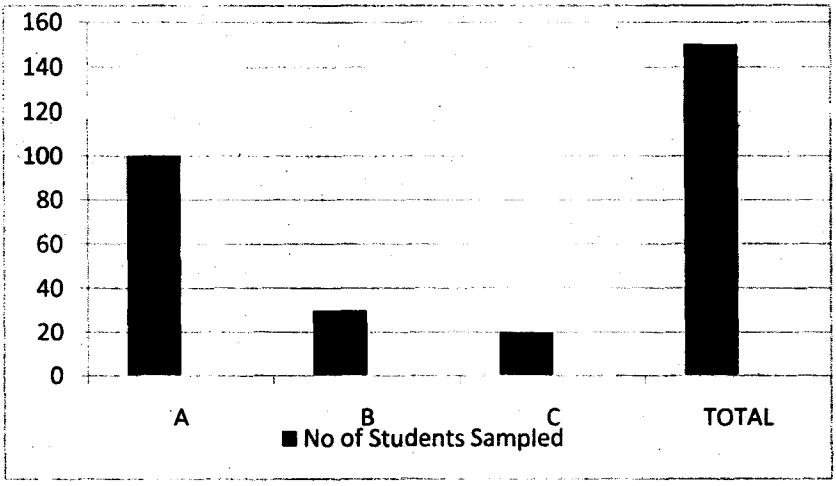

Fig 3: Study Sample Size Distribution

DATA COLLECTION INSTRUMENTS

The study employed two data collection instruments viz:

i. Students' Ability Assessment Test (SAAT).
ii. Students' Semester Physics Examination (SSPE).

ADMINISTRATION OF THE RESEARCH INSTRUMENTS

The SAAT was administered by the Physics teacher of the sampled students, and was designed to assess the students' mathematical abilities, spatial intelligence, problem analysis skills, and their abilities to develop concepts and apply same to problems in Physics.

The examination scores of the students after their semester Physics course examination were obtained, compiled, and subsequently used as the Students' Semester Physics Examination (SSPE).

DATA COLLECTION PROCEDURE

A total of two instruments were used to collect information during the study. These instruments were designed to test the students':

i. Mathematical ability.
ii. Level of spatial intelligence.
iii. Ability to analyze problems, as well as develop and apply the concepts and principles of Physics to tackle them.

The SAAT was administered in the third week of the first semester when the students were just starting the Physics courses, while the SSPE was administered in the fourteenth week of the second semester when the lecturers had already been concluded and the teacher had interactedadequately with the students on the Physics course.

DATA ANALYSIS

Data analysis for the study was carried out using descriptive statistics. This involved the use numbers, percentages, frequency distribution, and bar-charts.

RESULTS

ANALYSIS, PRESENTATION, AND INTERPRETATION OF DATA

The study sought to find out students ability to reason in terms of mathematical insight, visualization or spatial ability, logic evaluation, and problem solving. The students were subjected to the SAAT, the scores of which were then compared against their scores in the SSPE. The SAAT comprised of selected questions from core areas of science intellectual abilities previously listed. The performance of the students in the SAAT is as shown in figure 4.

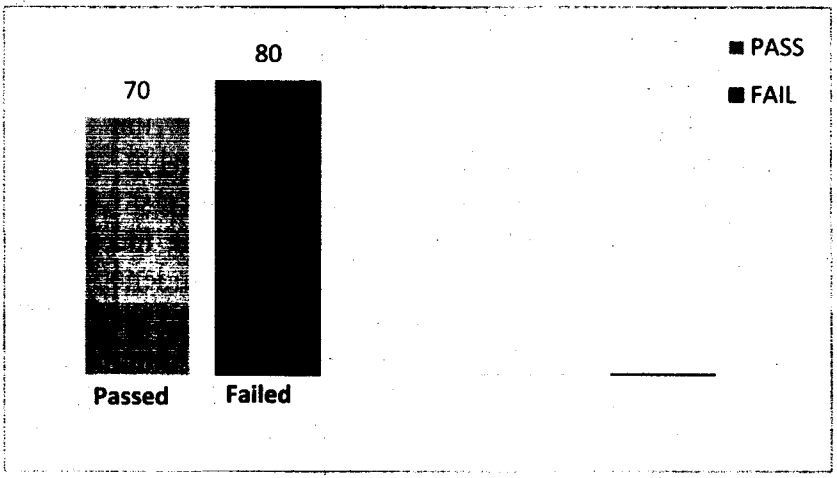

Fig 4: Overall Students, Students SAAT Score Distribution.

From the results of the SAAT, the students were then split into two groups and their scores in the SSPE were compiled accordingly. Those who passed the SAAT were labelled as group A, while those who failed the SAAT were labelled as group B. The performance of the students in the SSPE according to the two groups is as shown in figure 5.

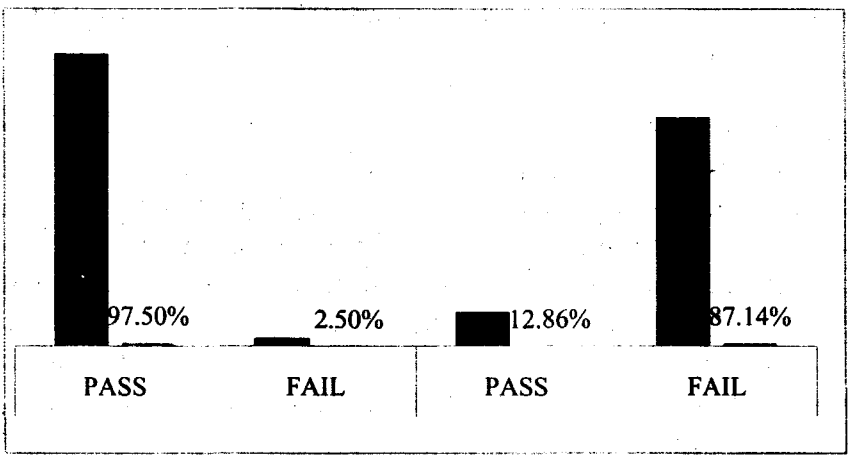

Fig 5: Groups A and B students SSPE Score distribution.

DISCUSSION

From the breakdown of the results, 53.3% of the students (labelled as group B) sampled failed the SAAT while 46.7% of the students (labelled as group B) passed the test. Amongst group A students, 97.50% passed Physics during the semester while 2.50% failed Physics. Amongst group B students, 12.86% passed Physics during the semester while 87.14% failed Physics.

An earlier independent study however showed that the institution has adequate instructional material and qualified teachers. Teachers' outlook, commitment, and approach to delivering Physics instructions were found to be reasonably high.

These results show a close correlation between students' performance in both the SAAT and their performance in the semester Physics course examination, as students who did well in the SAAT equally did well in the semester Physics examination, while those who performed poorly in the SAAT also recorded poor performance in the semester Physics examination, which supports the findings contained in KNEC's report of 2010.

CONCLUSION

The results from this study show that student's performance in physics courses is influenced by their intellectual abilities. More than half of the Physics students' population sampled was found to lack the requisite intellectual abilities required to excel in Physics. It was also established that many of the students offering Physics do not possess a solid foundation in the subject as a result of gaps created at the secondary school level.

RECOMMENDATIONS

In order to improve on the performance of students, the study came up with the following recommendations:

i. Greater effort should be put in by students of Physics or intending Physics students to develop their science intellectual abilities which are pre-requites for excellence in Physics.

ii. Effective career guidance and counselling at secondary school level should be rigorously pursued so as to adequately prepare the young ones before they eventually get to the tertiary level.

iii. In order to improve the performance of students in Physics teachers should:

- consider devoting extra time to students who have been found to be slow learners.
- adopt the use of demonstrations and activities that are attractive, lively, and more effective in Physics instruction.
- when necessary, split the class into very small groups or cells (e.g. during practicals or assessments) so as to ensure closer monitoring and one-on-one interaction with the students.

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