Physics Teacher Distinctive and Teaching Ability by Teacher Behaviour and Students' Achievement in Physics

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Abstract

Physics as a branch of pure science is introduced into the curriculum of secondary school because of its educational value, relevance to the need of individual learners and society as a whole. Reports from the public examining bodies indicate that not many students are passing the subject at credit level in spite of its importance, and this pose a threat to those who have stake in the subject. There had been studies on factors that may be influencing students' achievement, yet there is still need for improvement. The study investigated the association between teacher distinctive (qualification and teaching experience) and teacher teaching ability and senior secondary school students' achievement in physics. Thirty physics teachers and 1010 physics students were randomly selected from thirty senior secondary schools in Ogun and Oyo states, Nigeria. Two instruments were used to collect data: Teacher-students Interaction Observation Schedule (Cronbach alpha = 0.67) and physics achievement test (KR-20 = 0.85). The result of Pearson product moment correlation coefficient among teacher qualification ($r=1.17$, $p<0.05$), teaching experience ($r=0.95$, $p<0.05$) have significant relation; 76% have direct causal effect while 24% of the variables have indirect effect on students' achievement in physics. Results showed that there was a significant relationship between teacher qualification and teaching skills. It was therefore, recommended that teacher characteristics had influence on students' achievement in Physics.

Keywords: Teacher distinctive, Teachingability, Physics, Students' achievement in physics

Introductions

Physics is the branch of science that deals with the study of matter and energy and the interactions between them. Its importance to the society is evident in man's reliance on technology. The key to the technological advancement of any society lies with Physics-based technology, that is, Physics is the key that unlocks the technological advancement of any nation. The level of scientific and technological advancement of nations led to their classification as being developed, developing or underdeveloped. Nations such as The United States of America, Britain, Japan,

and Germany are classified as developed on the basis of the fact that they are technologically advanced. Similarly, many African such as Nigeria and Ghana are classified as developing because their technology is still at the rudimentary state. This can be shown in the level of students' performance in physics in school based and external examinations.

The level of performance of Senior School Certificate Examination (SSCE) students in the public examinations being conducted by West African Examination Council (WAEC) from 2007 to 2011, on the average, less than 60% of candidates who registered for physics passed at the distinction and credit levels. Several studies have been conducted in and outside the shores of this country to investigate the causes of students' under-achievement in Physics (Ajadi, 2017; Olukoya, 2011; Adegoke, 2003). Also, studies have shown that teacher-student interactions in the classroom have impact on students' attitude to physics and consequently achievement in physics (Ajadi, 2017). Gbagi (2011) blames teachers for poor performance of candidates in public examinations in the country, noting that teachers are not doing enough to educate their students and their failure in examinations has nothing to do with the government.

The success of classroom teaching and learning interaction depends to a large extent on the teachers' skills and abilities in classroom management. Teaching involves the use of many skills, such as preparation for the lesson, lesson presentation, organisation of the lesson and lesson evaluation at the end of the lesson to measure the extent to which the students have mastered the contents of the lesson. In teaching preparation, the teacher has to consider the capabilities of the students, the time limit for the lesson, the entry behaviour of the students, and the appropriateness of the methods of instruction he or she wishes to adopt. The teachers must be skilful in arranging the content of the lesson note and materials to be learnt must be presented in a logical manner. Also the teacher must skilfully look for instructional/learning material(s) for the lesson to be real and interesting for the students and reduce the level of abstractness that students usually attach to the learning of topics in Physics.

Presentation of the lesson starts from introduction. Introduction has to do with the different activities needed for initiating and introducing the students to the new lesson so as to arouse their

interest (Ajadi, 2017). This could be by oral questioning, short story or events that similar to the experiences in the new lesson. The teacher needs skills in linking students' past experiences with the new topic. Teachers should be skilful in presentation of the contents of the lesson. This is because the materials to be learnt should be presented in a systematic way. The learners learn more when they are led from known to unknown or from simple to complex. That is the teacher must present the lesson so as to create a situation in which what the students learn in one step forms the basis of what they will learn in subsequent steps.

Teachers' organisation determines how efficiently time is used. Eggen & Kauchak (2001) define organisation as 'the set of teacher actions that increase the instructional time'. Ayodele and Adegbile (2003) found that an effective teacher should always be clearly organising what he/she does in the classroom. A good teacher should be able to know the proper sequence of his lessons and the topics to be taught. Teaching is not accidental; it involves a lot of planning. Classroom organisation skill enhances the creation of an atmosphere of efficiency for the teachers' and students' time, efforts and energies (Ajadi, 2017). The class is made up of students from diverse backgrounds and who have different characters. The behaviour of these students can positively or negatively affect the morale of the teacher. A good classroom organisation aids in controlling the class. Teachers should plan purposefully for students' learning in such a way that requires a careful analysis of goal and careful selection of appropriate contents for students (Ajadi, 2017; Eggen & Kauchak, 2001). The seating arrangement depends on the classroom size, subject- matter, and method of teaching. In certain rational or organised ways, the new ideas or values are intentionally added to those already held ones in such a way that they fit in (Onwuegbu, 2000).

The last classroom teaching skill is evaluation. Evaluation of cognitive learning involves measuring students' knowledge and understanding in a subject by means of oral or written tests. Through this the teacher will be able to determine the extent to which students have mastered the contents of the lesson taught. According to McFarland (2003), through evaluation of the lesson objectives, teachers are able to give a

value or quantify the progress which the students have made in his or her learning. A skilful teacher, during evaluation period should ask questions that cut across the six levels of behavioural objectives of Benjamin Bloom (that is knowledge, compression, application, analysis, synthesis and evaluation). That is questions should test both the lower and higher level of cognition.

There is a need to empirically determine whether classroom practices, in concert with other teacher characteristics (teachers' qualification, and teaching experience), have an impact on student achievement in Physics. Teacher characteristics are comprised of teacher effectiveness and teachers' pedagogical content knowledge. Teacher effectiveness refers to the teacher's ability to produce student learning. Goldhaber and Brewer (2000) have shown that teacher characteristics (qualification and teaching experience) are related to students 'learning outcomes and a positive correlation between Physics knowledge and greater levels of performance among students whose teachers held bachelor's degree in physics than among those whose teachers did not hold degree in physics. Teachers' qualifications encompass teachers' scores on tests and examinations, their years of experience, the extent of their preparation in subject matter and pedagogy, what qualifications they hold in their areas of specialisation, and their on-going professional development.

Teaching experience has long been thought to affect teaching skills, with more experienced teachers associated with greater teaching effectiveness (Oladokun, 2010). Adeyemi (2008) reported that students taught by more experienced teachers achieve at a higher level because their teachers have mastered the content and have acquired classroom skills to deal with different types of classroom problems.Allen (2010) reported that inexperienced teachers typically express concern about lacking effective means of organizing the classroom and handling disruptive behaviours of students. Ajadi, (2017) and Goldhaber and Brewer (2000) found that students taught by experienced teachers performed significantly better than those taught by non-experienced teachers in science process skill acquisition and teacher experience positively related to higher school students achievement in Physics. The teachers who have spent more time studying and teaching are more effective

overall and they develop higher order thinking skills for meeting the needs of diverse students, and hence, increasing their performance. The years of teaching experience and qualification tend to affect students' achievement; the pattern of the affect has not been thoroughly researched. To achieve this, a path analytic model of teacher distinctive, teaching ability and students' achievement in senior secondary school physics was proposed (See Figure 1) to show the extent to which teachers' qualification and teaching experience can influence teachers' skills in lesson preparation, presentation, organisation and evaluation and consequently enhance students' achievement in physics.

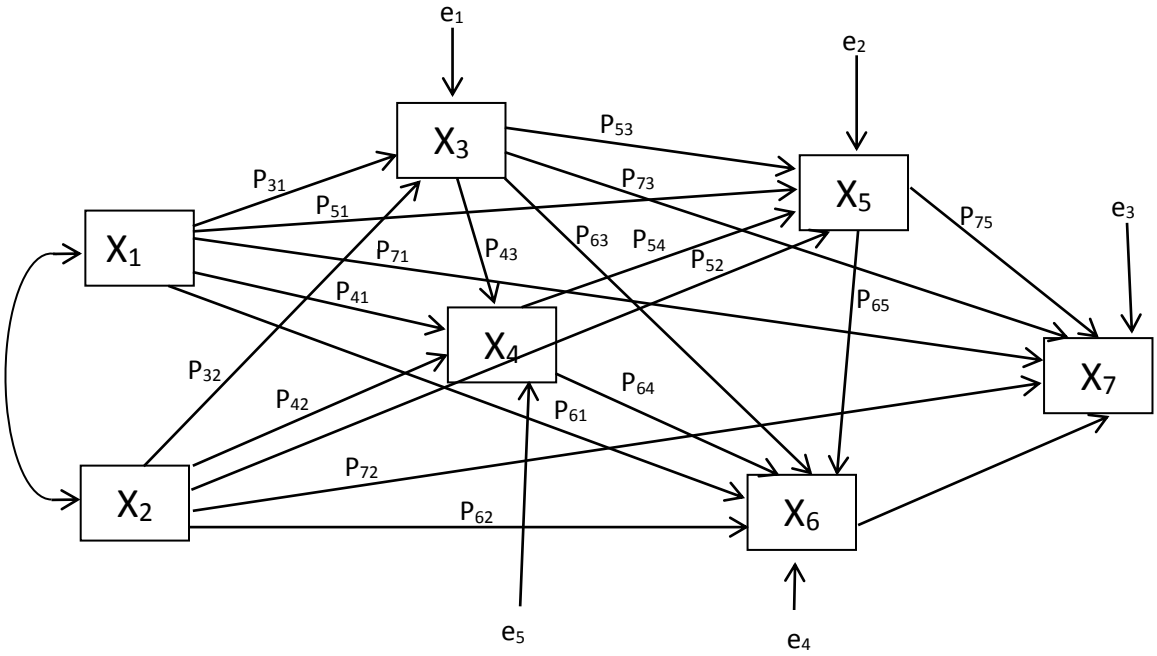


Figure1. **Recursive Path Model of Students' Achievement in Physics Factors**

Key: X_1 = Teacher Qualification; X_2 = Teacher Teaching Experience; X_3 = Lesson Preparation; X_4 = Presentation of Lesson; X_5 =Lesson Organisation;X_6 = Teaching Evaluation; X_7 = Students Achievement in Physics.

Research Questions

This study answered the following research questions.

1. What is the magnitude and direction of association that exists among teacher distinctive, teaching ability variables and students' achievement in Physics?
2. Is the model which describes the causal effects among the teacher distinctive (qualification and teaching experience), teaching ability (preparation,

presentation, organisation and evaluation of lesson) and students' achievement in physics consistent with the observed model?

3. If the model is consistent, what are the estimated direct, indirect, and total causal effects of teacher qualification, teaching experience, preparation, presentation, organisation, evaluation, and achievement in physics?

Methodology

Research Design

Correlational design was adopted for this study and path analysis was used to assess the tenability of the hypothesised model.

Sampling Technique and Sample

Thirty physics teachers and 1010 senior secondary school physics students were selected from thirty senior secondary schools (SSS) in Ogun and Oyo States, using proportionate-to-size sample technique. The student ages ranged between 15 and 19^{+}years and the age of physics teachers ranged between 30 and 50 years. The teaching experience of the teachers at the SSS level was five years and above.

Instrumentation

Two instruments were used for this study. They are: Teacher-Students Interaction Observation Schedule (TSIOS), and Physics Achievement Test (PAT).

TSIOS developed by Abanihe (2008) was adapted. Section A consisted of 5 items on teacher gender, teacher qualification, class observed, time lesson started and time lesson stopped. Section B consisted 40 items on seven different dimensions of the teaching-learning process: preparation, introduction, presentation, communication, development, organisation and evaluation. Four of these: lesson preparation, presentation of lesson, lesson organisation and lesson evaluation were used in this study. Each section consisted of five to six items. Reliability of TSIOS was 0.67. TSIOS measured teacher qualification as NCE = 1; HND = 2, B.Sc. (Physics + Education) = 3; Master Degree in Physics = 4; PhD (Physics + Education) = 5. Section B of TSIOS was scored as Poor = 1, Fair = 2, Good = 3; Very Good = 4 and Excellent = 5 for each of the four sections.

PAT was developed by researcher; this instrument had earlier been used by Ajadi 2017 to test students' intellectual achievement in seven selected topics in senior secondary school physics (motion, linear momentum, work, energy, power, heat and temperature). An initial draft of 80 items with four-point response format was used. The test items were constructed based on the first three domains of cognition (knowledge, comprehension, and application) using a table of specification.

The content validity of the items was ensured given them to teachers and expert in physics. PAT was subjected to item analysis and the item difficulty and discrimination indices were established using the 2-parameter model of Item Response Theory. On the basis of Test Information Function, items with difficulty parameters ranged from -1.34 and +1.86. The discrimination indices of the items ranged from 0.26 and 0.49. The final PAT comprised 40 items and the reliability of 0.85 was estimated for the test.

Procedure for Data Collection

Thirty physics teachers were observed for 10 lessons during the normal teaching periods in each school. This was to avoid disruptions to scheduled school programmes. Three research assistants used were assigned to each classroom for the observation and coding of teacher activities as spelt out in TSIOS. Each lesson was coded for 40 minutes. The inter-rater reliability of the coding ascertained using Scot's Pi ranged from = 0. 82 to 0.87.

Data Analysis

Data gathered were analysed using AMOS 23to establish the correlation and test the hypothesised model among the variables.

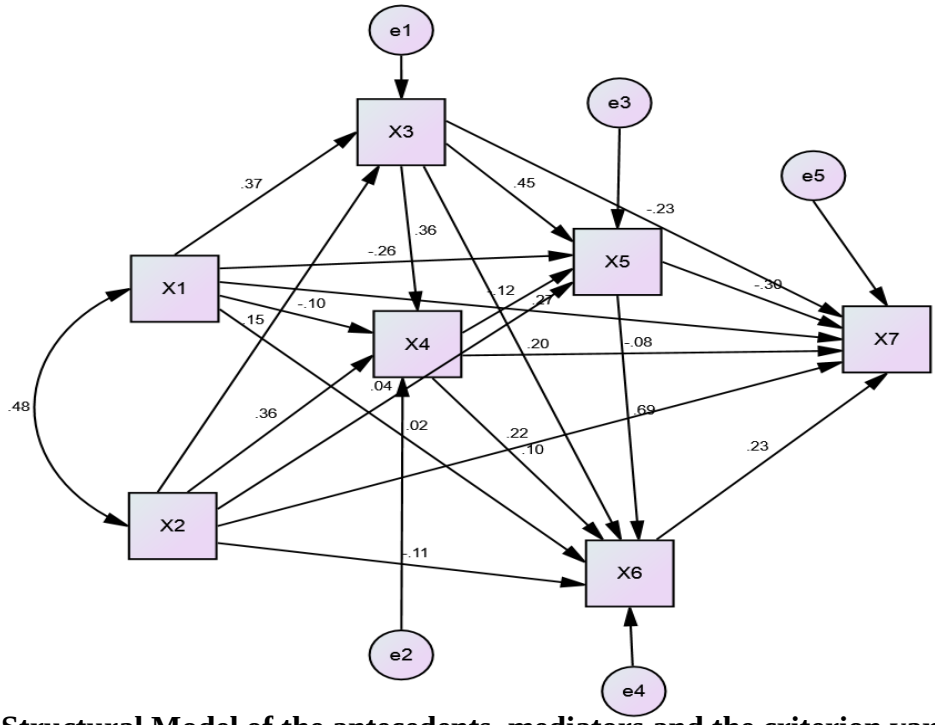


Figure. 2: Structural Model of the antecedents, mediators and the criterion variables

Key: X_1 = Teacher Qualification; X_2 = Teacher Teaching Experience; X_3 = Lesson Preparation; X_4 = Presentation of Lesson; X_5 = Lesson Organisation; X_6 = Teaching Evaluation; X_7 = Students Achievement in Physics.

Results

Research Question 1: What is the magnitude and direction of association that exists among teacher distinctive (teacher qualification, and teaching experience), teaching ability and students' achievement in Physics?

Table 1: Correlational Matrix and Descriptive Statistics for the Association between Teacher Distinctive and Teaching Ability Variables (N =1010)

Variables	1	2	3	4	5	6	7
1.**Qualification** (QL)	1.00						
2.**Experience** (EP)	0.48*	1.00					
3.**Preparation** (PP)	0.37*	0.23*	1.00				
4.**Presentation** (PS)	-0.13*	0.46*	0.30*	1.00			
5.**Organisation** (OS)	-0.76*	0.12*	0.87*	-0.28*	1.00		
6.**Evaluation** (EVA)	0.04	-0.30*	0.36*	0.22*	0.64*	1.00	
7.**Physics Achi** (PA)	1.17*	0.95*	-0.64*	-0.26	-0.43	0.36*	1.00
Mean	**2.66**	**2.78**	**13.62**	**10.04**	**15.12**	**19.44**	**31.93**
SD	**1.14**	**1.15**	**1.76**	**1.46**	**3.37**	**3.15**	**4.85**

* Significant at, p<.05

A matrix of Pearson's product-moment correlation coefficients in Table 1, showing teacher distinctive (teacher qualification and teaching experience), classroom behaviour (teachers' skill in lesson preparation, presentation, organisation of lesson, and evaluation) and achievement in physics (criterion) scores was calculated. Table 1 show that the association between students' achievement in physics and each of the predictors was low, except for teacher qualification (1.17) and teaching experience (0.95). The association were statistically significant (at $p < 0.05$) except for of lesson preparation (-0.64), lesson presentation (-0.26)and organisation of lesson (-0.43). However, the table shows very good association between teachers' qualification and teaching experience; teacher qualification and lesson preparation; teachers' qualification and physics achievement. The table also shows a fair association between teaching experience and teacher skills in preparation and

presentation of lesson. The relationship between skill in lesson presentation and lesson organisation was also good. These associations explain that teachers 'distinctive such as qualification and experience are related to teacher teaching skills. For example the higher the qualification of the teacher the better he or she is in lesson preparation, lesson presentation, and organisation. In the same vein, the more experienced the physics teacher is the better the teacher is in lesson preparation, presentation, lesson organisation, and evaluation of the lesson.

Model Testing

The hypothesised path model of Figure 1 was fitted to covariance matrix constructed from the correlations and standard deviations of Table 1 with AMOS 23. Testing the hypothesised model involved examining the overall fit of the hypothetical structural equation model of the data.

Research Question 2: Is the model which describes the causal effects among the teacher distinctive (qualification and teaching experience), teaching ability (preparation, presentation, organisation and evaluation of lesson) and students' achievement in physics consistent with the observed mode?

Table 2: Significant Paths of the Hypothesized Model

Paths	Path Coefficient	Significance	Decision
P_{31}	0.57*	S	Retain
P_{41}	-0.13*	S	Retain
P_{51}	-0.76*	S	Retain
P_{61}	0.04	NS	Delete
P_{71}	1.17*	S	Retain
P_{32}	0.23*	S	Retain
P_{42}	0.46*	S	Retain
P_{52}	0.12*	S	Retain
P_{62}	-0.30*	S	Retain
P_{72}	0.95*	S	Retain
P_{43}	0.30*	S	Retain
P_{53}	0.87*	S	Retain
P_{63}	0.36*	S	Retain
P_{73}	-0.64*	S	Retain
P_{54}	-0.28*	S	Retain
P_{64}	0.22*	S	Retain
P_{74}	-0.26*	S	Retain
P_{65}	0.64*	S	Retain
P_{75}	-0.43*	S	Retain
P_{76}	0.36*	S	Retain

Key: *S = Significant Path, NS = Non-Significant, (*) = Significant Correlation Coefficient.*

Table 2 above represents the significant and non-significant paths for 20 paths that show the causal relationship among the variables (predictor and criterion). The 19 significant paths were retained and 1 non-significant causal relationship was trimmed off to arrive at meaningful causal model to explain teacher qualification, teaching experience, lesson preparation, lesson presentation, lesson organisation, evaluation, and students' achievement in physics. The new criteria for the significant path as recommended by Ajadi (2017); Adegoke (2009);Kline (2005); Kerlinger (2000) was that both path coefficient and zero order correlation must be significant at $p<0.05$.

Research Question 3: If the model is consistent, what are the estimated direct, indirect, and total causal effects of teacher qualification, teaching experience, preparation, presentation, organisation, evaluation, and achievement in physics?

Table 3: Direct and Indirect Path Coefficients of the Physics Achievement Model

Path	Direct Effect	Indirect Effect	Total Effect
To Lesson Preparation			
Teacher Qualification (QL)	0.37	0.00	0.37
Teaching Experience (EP)	0.15	0.00	0.15
To Lesson Presentation			
Teacher Qualification (QL)	-0.10	0.14	0.04
Teaching Experience (EP)	0.36	0.06	0.42
Lesson Preparation (PP)	0.37	0.00	0.37
To Organisation			
Teacher Qualification (QL)	-0.26	0.16	-0.10
Teaching Experience (EP)	0.04	0.02	0.06
Lesson Preparation (PP)	0.45	-0.05	0.40
Lesson Presentation (PS)	-0.12	0.00	-0.12
To Evaluation			
Teacher Qualification (QL)	0.02	0.01	0.03
Teaching Experience (EP)	-0.11	0.12	0.01
Lesson Preparation (PP)	0.20	0.32	0.52
Lesson Presentation (PS)	0.10	-0.09	0.01
Lesson Organisation (OZ)	0.69	0.00	0.69
To Physics Achievement			
Teacher Qualification (QL)	0.27	-0.06	0.21
Teaching Experience (EP)	0.23	-0.09	0.14
Lesson Preparation (PP)	-0.23	-0.03	-0.26
Lesson Presentation (PS)	-0.08	0.04	-0.04
Lesson Organisation (OZ)	-0.30	0.16	-0.14
Lesson Evaluation (EVA)	0.23	0.00	0.23
TOTAL	**2.28**	**0.71**	**2.99**

Table 4: Proportion of Direct and Indirect Effect of Independent Variables on Student Achievement in Physics

Effect	Frequency	Percentage
Direct	2.28	76%
Indirect	0.71	24%
Total	**2.99**	**100%**

Table 4 shows the result that 76.0 % of the causal effects among teacher qualification, teaching experience, lesson preparation, lesson presentation, lesson organisation, lesson evaluation, and students' achievement in physics are direct while 24% of the causal association among the variables in the model is indirect. This result is in line with recommendation that, it is better for variables in the model to be directly influenced the criterion variable than for the effects to be indirect (Kerlinger and Lee, 2000).

Direct Effects

Once the model achieves an overall satisfactory fit, the second step in the model testing is the examination of statistical significance of each of the hypothesised direct and indirect effects.

Indirect Effects

Indirect effects are estimated statistically as the product of direct effects, which comprise them. They are also interpreted just as path coefficients. For example, the standardised indirect effect of teacher qualification on physics achievement is estimated as the product of the standardised coefficients for the paths (QL to PP) (PP to PA) + (QL to OZ)(OZ to PA) + (QL to PP)(PP to OZ)(OZ to PA) + (QL to PS)(PS to OZ)(OZ to PA) + (QL to PS)(PS to PA) + (QL to OZ)(OZ to EVA)(EVA to PA) + (QL to EVA)(EVA to PA). Mathematically this equals (-0.07) + (-0.56) + (0.0659) + (-0.84) + (-0.39) + (-0.175104) + (0.0144) = -1.954804 (About -1.95). Likewise, indirect effect of teaching experience on physics achievement is about -1.23. Others were calculated using the same method. However note that the path from teacher qualification (TQ) to teaching experience (TE) was not analysed because they were the exogenous variables in the model.

Discussion

Classroom interactions are planned and organised behaviour which the teacher tries to exhibit as he/she passes on the subject matter content to learners. It is the relationship between the teacher, the

students and teaching learning process. The findings of this study show that although there were significant association among teacher qualification, teaching experience and abilities in lesson preparation, organisation, presentation and evaluation, also, teacher qualification, teaching experience, lesson preparation, organisation, and evaluation had strong association on students' achievement in physics. The most influential factors in this study were teacher qualification and teaching experience. This finding is consistent with Mayer, Mullens and Moore (2000), the most important factor in improving students' achievement is having a well-qualified teacher in every classroom and good teaching is enhanced when teachers teach in the field in which they are trained; and have more year of teaching experience. Ajadi (2017) reported positive relationship between students' achievement in physics and teachers with a major in Physics teaching experience and mastery of subject matter. This is because experienced teachers have mastered the content of the subject matter and have acquired classroom skills to deal with different types of classroom problems. Teachers who have spent more time studying and teaching are more effective overall and they develop higher thinking abilities for meeting the needs of diverse students and hence, increasing their performance (Ajadi, 2017).However, inexperienced teachers typically express concern about lacking effective means of preparing the lesson, organising the classroom and handling significant disruptive behaviour of students. Therefore, inexperienced teachers are less effective than the more senior teachers.

Recommendation

The study shows the need for teacher recruiting establishments, such as the Teaching Service Commission and State Ministry/Department of Education to ensure that only academically qualified personnel are employed to teach physics in senior secondary schools.

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