Effect of Teacher Characteristics on Learner Academic Achievement in Physics in Kenyan Secondary Schools

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Abstract

Educationist have been concerned about low academic achievement in physics in secondary schools. A number of factors have been blamed for this low academic achievement, one of them being the teacher characteristics. The purpose of this study was to investigate the effect of teacher characteristics on academic achievement of students taking physics in Kenyan secondary schools. The study employed survey design in collecting data on teacher characteristics. Student achievement test was used to obtain data on leaner academic achievement. A sample of 92 teachers in 84 schools and all form three students taking physics were involved in the study. Stratified sampling was used to select 12 schools from each of the former seven provinces in Kenya. Data on teacher characteristics was collected using a questionnaire while learner academic achievement was measured using student assessment test. The results were analyzed using ANOVA to test the hypotheses. The findings were that teachers of high academic qualifications produced high results than students taught by teachers of low qualifications. Gender and experience were not factors in influencing learner academic achievement while teaching experience contributed to high learning outcome. In view of these findings, the researcher recommends that teachers should be well trained and that their promotion should be based on academic qualifications and teaching experience. Teachers of both gender should be involved in teaching physics.

Key words: teacher characteristic; physics, learner academic achievement

1.0 Introduction

Physics is one of the major science subjects offered in Kenyan secondary schools. Taylor (1974) opined that physics is a fundamental subject and that other sciences depend on the applications of

its principles, for instance, apparatus used in chemistry and biology apply the principles of physics. Zhaoyao (2002) says that physics lays a good base for technological advancement which is required for any nation to develop both technologically and economically. Furthermore, most scientific and technological careers like engineering and architecture offered in universities and higher institutions of learning require background knowledge of physics. Alluding to its importance Amadalo, (2010) observe that physics enable learners to develop critical thinking skills which are essential for solving day to day life problems. Further, Das (1995) opined that the study of physics involves the pursuit of truth, honesty and diligence. This help one to become a better citizen who can be trusted and live in harmony with the environment.

Despite of the importance of physics, it has been noted that learners have continued to register low grades in national examinations (KNEC, 2018). This low learner academic achievement has been attributed to a number of factors, among them teacher characteristics. Several studies have been done to investigate the relationship between teacher academic qualifications, experience , gender, attitude and experience on the learner academic achievement (Amadalo, 2017; Noor and Hamidom, 2016; Buddin and Zenro, 2009; Douglas and Tim, 2011; Papay and Matthew, 2015; Judith and Anyagre, 2017; Muriithi, 2013).

Noor and Hamidon (2016) argue that educators are looking for ways to improve academic achievement in the science subjects. Jepsen (2015) notes that teachers have strong influence on learner achievement. He says that teacher characteristics are key in determining the academic achievement of learners especially in early years of learning. In his study on teacher characteristic and student achievement, he noted that teacher's educational background and teaching experience are key determinants of learner academic achievement. These finding concur with those of Buddin and Gema (2009) who did a study in Los Angeles, California on the relationship between teacher

qualifications and student achievement in urban elementary schools. They found large difference in teacher quality where some teachers were high qualified academically while others were not. However, the findings indicated that learner academic achievement was not influenced by teacher qualifications. This implies that other factors also play a role in determining learner academic achievement in different subjects.

Teaching experience also plays a role in learner academic achievement. Amadalo (2010) notes that teachers keep learning from their peers and this improves their pedagogical skills which translate to high academic achievement. Buddin (2009) noted that student academic achievement increases with teacher experience. However, in the same study on teacher qualification and student achievement in urban elementary schools, Buddin and Gema (2009) found that there is very little link between teacher experience and learner academic achievement in the first two years of teaching. However, Douglas and Tim (2011) found that productivity of teachers in elementary and middle schools increased with experience. They found that teachers gain a lot of teaching experience in the early years of their teaching career. These findings are in agreement with those of Papay and Matthew (2015) who found that teacher productivity improved with experience. On the other hand, Judith and Anyagre (2017) found out that there is no significant difference between teacher experience and their efficacy which determines learner academic achievement.

Educators have also been concerned on the role of teacher's gender on learner academic achievement. Twoli (1996) found that both male and female teachers have the same chance of producing similar results. Amadalo (2010) notes that there is conservative and stereotype ideas and expectations on gender issues where male teachers are expected to do more and produce better results than their female counterparts. Ross and Collaghan (2004) notes that attitudes on gender of teachers and teacher educators have remained conservative over the years. Millar and Osborne

(1998) noted that teaching profession had been labelled “feminine” which is more of an attitude than reality.

1.1 Problem statement

Most research findings on the relationship between teacher characteristics and learner academic achievement are not conclusive as they are based on general learner academic achievement in all the subjects. Some findings also are contradictory where one study says that experience affects academic achievement while other studies shows that experience does not. This study attempted to find out the relationship between characteristics of physics teachers and learners academic achievement in secondary schools in Kenya.

1.2 Purpose of the study

The purpose of this study was to investigate the relationship between teacher characteristics and learner academic achievement in physics in Kenyan secondary schools

1.3 Objectives of the study

The specific objectives of the study were:

i. To examine the relationship between teacher academic qualifications and learner academic achievement in Physics
ii. To determine the relationship between teacher experience and learner academic achievement in physics
iii. To assess the relationship between teacher gender and learner academic achievement in physics

1.4 Study hypotheses

i. There is no relationship between teacher academic qualifications and learner academic achievement in physics
ii. There is no relationship between teacher experience and learner academic achievement in physics
iii. There is no relationship between teacher gender and learner academic achievement in physics

1.5 Significance of the study

The findings of this study are significant to teacher trainers, teacher employers and policy makers. Teacher trainers can use these findings when admitting students in the pre-service programme and admit students of any experience and gender. The government can also design in-service programme based on these findings. The findings should also guide policy on employment, deployment, promotion and training criteria of physics teachers.

2.0 Research methodology

Survey design was used to gather information on physics teacher characteristics. Student Achievement Test was administered to students after a given topic was taught by the teachers involved in the study. All physics teachers in Kenyan secondary schools formed the population of the study. Stratified sampling was use to select 92 teachers from 84 provincial secondary schools. 12 schools comprising 4 boys school, 4 mixed schools and 4 girls' schools were each selected from seven out of eight former provinces in Kenya. The criteria for selection was their academic achievement in the finals examinations, the Kenya Certificate of secondary Education (KCSE) examinations. Data on teacher characteristics was collected using a questionnaire while a student

achievement test (SAT) was used to obtain data on learner academic achievement. This test was administered to students immediately after the selected topic was taught. The research instruments were validated by Education experts from the University of Nairobi. Data was then analyzed using SPSS 17.0 computer software.

The test scores from this study were used to determine the academic achievement of the learners. The test scores were converted to percent experience s. The mean score from each school was then calculated. This mean score was then compared to the teacher characteristics of those involved in teaching. The relationship between teacher characteristics and learner academic achievement in physics was compared using the chi-square. The hypotheses were tested at 95% level of confidence.

3.0 Findings and discussions

3.1 Teacher academic qualifications and learner academic achievement in physics

The first objective was to examine the relationship between teacher academic qualifications and learner academic achievement in physics. Teachers academic qualifications were compared to the percent experience score attained by students in the student achievement tests. The results are summarized in Table 1.

Table 1: Teacher qualifications and learner academic achievement

Qualifications	Frequency	% score by students
Diploma in Education	24	40.26
Bachelor of science (BSc)	6	36.48
BSc and PGDE	7	43.12
Bachelor of Education	49	48.64
Master of Education	4	50.24
Bachelor of Engineering	2	38.48

Table 1 shows that students who were taught by teachers with Diploma in Education qualifications scored 40.26%; those taught by teachers with a Bachelor of Science degree scored 36.48%; those taught by teachers with a Bachelor of Science degree and Post Graduate Diploma in Education (PGDE) scored 43.12%; those taught by teachers with a Bachelor of Education degree scored 48.64%; those taught by teachers with a Master of Education scored 50.24% whereas those taught by teachers with a Bachelor of Engineering degree scored 38.4%.

From these results, it can be seen that the order of learner academic achievement increased as the level of academic qualifications increased from Diploma in Education to Bachelor of Science with PGDE, Bachelor of Education and then Master of Education with the scores obtained as 40.26%, 43.12, 48.54% and 50.48% respectively. These are teachers who have academic knowledge and pedagogical skills in physics education. The lowest level of training is Diploma in Education, followed by Bachelor of Science with PGDE, Bachelor of Education degree and then Master of Education degree. These findings indicate that the learner academic achievement increases as the qualification of teacher increases.

Other teachers with a Bachelor of Science degree and Bachelor of Engineering degree have the academic knowledge but lacks pedagogical skills necessary for teaching. Their students scored 36.48% and 38.38% respectively. These scores are lower than the scores achieved by students taught by teachers with pedagogical skills. This indicates that teachers with both academic and pedagogical skills are more qualified to teach physics than those without pedagogical skills.

In order to check if the results obtained by teachers with pedagogical skills and those without were significant, the mean scores were subjected to ANOVA test. Table 2 gives the summary of these analysis.

Table 2: Comparison of scores

	Sum of squares	Mean square	F	Significance
Between groups	1046.911	133.771	7.737	.430
Within groups	54 400	18.133		
Total	1101.311			

From Table 2, it can be observed that the value of f is 7.737 which is greater than the tabled value of 4.36. The level of confidence was .005 when the df was v_1=40 and v_2=5. This indicates that there is significant contribution of training implying that teachers with pedagogical skills produced superior results as compared to their counterparts who had no pedagogical skills.

3.2 Teacher experience and learner academic achievement

The second objective was to determine the relationship between the experience of the teacher and learner academic achievement in physics. The experience of the teachers were matched with the aver experience mean score attained by their students. Table 3 gives a summary of this analysis.

Table 3: Teacher experience and test score

experience bracket	**Frequency**	**% test score**
Below 5	2	50.25
6-10	22	36.48
11-15	20	43.12
16-20	17	50.98
21-25	15	42.48
Above 25	16	47. 46

Table 3 shows that teachers whose experience is below 5 years produced a mean score of 50.25%; teachers of experience 6 to 10 produced a mean score or 35.48%; those of experience 11 to 15 years produced a mean score of 43.12%; teachers of experience of 16 to 20 years had a mean score of 50.98%; those of experience 21 to 25 had a mean score of 42.48% while those with experience above 25 years had a mean score of 47.46%. A close look at the percent score indicates no relationship between teaching experience of the teacher and the scores attained by the learners. Multiple regression model was used to determine the contribution made by experience in learner's academic achievement in physics. Table 4 gives a summary of the findings.

Table 4: Regression for Teacher's experience and learner academic achievement

	Un-standardized coefficient		Standardized coefficient		
	β	Std. error	Beta	t	
Constant	36.233	1.753		20.674	Sig.
Teaching experience	0.0205	0.277	0.077	0.739	0.206

Table 4 shows that the coefficient of determinant is 0.0205. The coefficient of determinant indicates the extent to which changes in the dependent variable are affected by the independent variable. In this case, the independent variable is the experience of the teacher while the dependent variable is the academic achievement of the learners. This indicates that experience of the teachers contributes only 2.05% to the academic achievement of the learners. This is a small percent indicating that experience of the teacher is not a factor in the academic achievement of the learners.

The constant in Table 4 is 36.233. Therefore the model generated as

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + E$ becomes

$Y = 0.0205\ X_1 + 36.233$

Y stands for the academic achievement while x is the experience variable.

According to this model and the findings in Table 4, while taking all factors constant, an increase in experience will lead to a 2.05% increase in academic achievement. These findings contrast that of Gumo (2005) who had indicated that teacher's experience is necessary in fostering intellectual growth and curiosity to learn. Young teachers are also said to be more energetic, hence are visionary, creative and ready to learn from their counterparts (Sotto, 2007). This is evidenced in this study which shows that teachers with less than five years of teaching experience enabled their students to score 50.25% which was above others.

3.3 Teacher gender and learner academic achievement

The third objective aimed at establishing the relationship between gender of the teachers and learner's academic achievement. Table 5 shows the gender, frequency and the percent scores attained by the students.

Table 5: Gender and test scores

Gender	Frequency	% test score
Male	80	70.75%
Female	12	62.50%

Table 5 indicates that male teachers produced a mean score of 70.75% as compared to a mean of 62.59% produced by their female counterparts. In order to compare the contribution made by the gender, the data collected was exposed to regression model whose findings are shown in Table 6.

Table 6: Regression for Teacher gender and learner academic achievement

	Un-standardized coefficient		Standardized coefficient		
	β	Std. error	Beta	t	
Constant	36.233	1.753		20.674	Sig.
Gender	1.592	1.249	0.133	1.275	0

From Table 6, the coefficient of determinant is 0.133 indicating that 13.3% of variation in learner academic achievement can be attributed to gender of the teacher. This implies that other factors other than gender of the teacher contributes 86.7% to learner's academic achievement.

In order to test the hypothesis that there is no relationship between gender of the teacher and learner academic achievement, the data collected was subjected to ANOVA test. Table 7 gives the summary of this analysis.

Table 7: ANOVA model for teachers' gender and academic achievement

	Sum of squares	df	Mean square	F	Sig.
Regression	42.369	2	21.184	1.169	0.0315
Residual	1631.376	90	18.126		
Total		92			

The calculated value of f is 1.169 is less than the tabled value of 9.50 when v1=90 and v2=2 t 0.05 level of significance. This implies that the null hypothesis was accepted implying that there is no relationship between gender of the teacher and learner academic achievement in physics.

4.0 Conclusions

From the analysis done and discussed in the previous sections, the study concludes that

i. There is a positive relationship between teacher academic qualification and leaner academic achievement in physics. Teachers with high academic qualifications produced better results as compared to teachers of low academic qualifications. Moreover, teachers with both academic and pedagogical qualifications produced better scores than those without pedagogical qualifications.
ii. There is no relationship between experience of the teacher and leaner academic achievement in physics. This implies that teachers with less years of teaching experience can produce the same or better results than those with more years of teaching experience.
iii. There is no relationship between gender of the teacher and leaner academic achievement in physics. This implies that both male and female teachers are capable of teaching physics effectively.

5.0 Recommendations

Based on these findings, the researcher recommends that:

i. Rigorous pre-service and in-service programmes be undertaken so as to have high qualified physics teachers who have the capacity and competence to teach and enable the learners to get high results that will enable them to pursue science related careers.
ii. Training, employment, promotion and deployment should not be based on years of teaching experience.
iii. Training, employment, promotion and deployment should not be based on gender as both male and female teachers are capable of doing equally well in teaching.
iv. Teachers without pedagogical qualifications should be trained on pedagogy to improve their teaching skills for better learner academic achievement.

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