

Teachers' Qualification and Errors Committed by Students in Science Practical

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Abstract:

The study focused on teachers' qualification and errors committed by students in science practical in senior secondary schools using descriptive research of the survey type. The participants were 243 of 1,563 science teachers in Ekiti State public senior secondary school who were selected through multi-stage sampling procedure from the three senatorial districts of the state. An instrument titled, 'Errors in Science Questionnaire' (ESQ) was used to collect data from the respondents. The data collected were collated and analysed using descriptive statistics involving frequency counts, mean and percentages. The results of the study revealed among others that errors in science practical were most frequent in physics practical and that most of the teachers teaching science subjects (particularly physics) in senior secondary schools were not qualified with its negative effect on teaching and learning of science. It was therefore recommended among others, that Government should embark on massive recruitment of qualified and experienced science teachers (particularly physics teachers) into the teaching service and encourage in-service trainings for science teachers for professional upgrading and competencies in their jobs which could help them to be more committed to practical oriented method of teaching and reduce the rate of errors committed by students during practical.

Keywords: Teachers' qualification, Students, Science Practical, Errors,

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Introduction

In the process of searching for knowledge and truth, man has accumulated a vast store of knowledge known as science. Science involved the systematic gathering of information through various forms of direct or in direct information, and the testing of such information to draw conclusion. One key component of science is practical work. Practical work in science is intended to teach the students how to select and set up apparatus correctly, to make careful observations and to give accurate reports. Students, if properly guided, could enjoy measuring, manipulating equipment, classifying data, designing experiment, testing hypotheses and making inferences. However, teachers of science are observed to be more committed to theory oriented methods of teaching than practical oriented method. This could be one of the reasons students seem to be more interested in the scores they will get from rote learning than putting more efforts in the mastery of the practical content. The few practical activities they carried out are observed to be full of errors. The poor achievement of students in science according to Ariyo (2006) has been a major concern to all. Also, Olufemi and Ibukun (2013) opined that students are expected to do well in science but, the reverse is the case. From general observations, the majority of students who failed science subjects in Senior Secondary School Certificate Examinations are usually those that are unable to accurately carryout experiments during the practical aspect of the examinations.

Errors are mistakes made during practical activities in science. Owolabi (2013) agreed that, there is always some degree of errors that could occur during science practical activities. It however appears that the degree of errors committed in science practical could be related to teachers' qualification. Qualification is a particular skill or type of experience or knowledge someone possesses to make him or her suitable to perform a particular task. Teachers' qualification according to Adetayo in Bello (2015) is one of the most important factors in the teaching and learning process. It could mean the skills a teacher required to teach effectively. Such skills could include formal education, experience, knowledge of subject matter, pedagogical skills, duration of training, certificate and professional development (Zuzovsky, 2009). Kosgei, Mise, Odera and Ayugi (2013) define a qualified teacher as one who has been fully certified and held the equivalent of a major in the field being taught. Hakielimu (2011) opined that teachers' qualifications and experiences are part of the many factors that determine the quality of teaching and learning. This is in line with the submissions of Aina and Olanipekun (2015) that a qualified teacher is crucial to any educational system. Hence, teacher's qualification can go a long way to bring about students' higher academic achievement.

Several studies had also revealed that professional development and experience count for teachers' qualifications (Rice, 2003; Helk, 2007). Bandele (2008) is of the opinion that there must be adequate and appropriate flow of knowledge from teacher to students. One of the ways this could be possible is through a qualified teacher. This corroborates the observation of Adetayo in Bello (2015) that teachers' use of available instructional or laboratory equipments depend significantly on their qualifications. This could be true because, in spite of the laudable effect of science practical to science teaching and learning, many teachers are not usually committed to engaging students with regular practical activities. This shortcoming could be part of the reasons for committing various degrees of

errors in science practical. In view of this the research was conducted to investigate the relationship between teachers' qualifications and errors committed by students in science practical.

Purpose of the Study

The purpose of the study was to investigate whether the teachers teaching science subjects in senior secondary schools are qualified, and to find out the relationship between teachers' qualifications and errors committed by students in science practical.

Research Questions

The following research questions were raised for the study:

1. Are teachers teaching science subjects in senior secondary schools qualified?
2. How frequently do errors occur in science practical?
3. In which of the three core fields of science (physics, chemistry and biology) are errors most frequent in science practical?

Methodology

This research employed a descriptive research of the survey type. Descriptive survey research design is a procedure whereby a unit of the population is studied in details so as to generalise the result on the entire population. The population for this study comprised all the teachers teaching physics, chemistry and biology in public senior secondary schools in Ekiti State, Nigeria numbering 1,563 as at the time of investigation. (Source: Ekiti State Teaching Service Commission).

A sample of 243 senior secondary school science teachers was drawn from nine local government areas across the three senatorial districts of Ekiti State. The sample was selected using multi-stage sampling procedure. At the first stage, three local government areas were selected from each of the senatorial districts using simple random sampling by balloting. The second stage involved the selection of senior secondary school science teachers across the selected three local government areas in each of the senatorial districts using stratified random sampling technique where subject (physics, chemistry and biology) was used as stratification variable. Consequently, 81 teachers comprising 27 physics teachers, 27 chemistry teachers and 27 biology teachers were randomly selected from each of the senatorial districts, making a total of 243 teachers across the three senatorial districts.

The only instrument that was used to collect relevant data for this study is a questionnaire tagged "Errors in Science Questionnaire" (ESQ). The instrument was developed to measure the frequent errors in physics, chemistry and biology practical activities. The instrument consists of sections A and B. Section A consists of the respondents' bio-data and preliminary information for science teachers while section B consists of 40 items which were used to elicit information on the frequency of errors in science practical. The responses were scored as follows: Very frequent (VF) – 4 points; frequent (F) – 3 points; Slightly frequent (SF) – 2 points; Not frequent (NF) – 1 point.

Face and content validity of the instrument were ascertained by experts in the field of Science Education, Test, Measurement and Evaluation. A reliability coefficient of 0.90 was obtained through split half method. Data collected were collated and analysed using descriptive statistics involving frequency counts, mean and percentages.

Results

Research Question 1: Are teachers teaching science subjects in senior secondary schools qualified?

In order to answer the question, the respondents' qualifications were grouped into four levels of qualifications. The respondents who were holders of degree in science education were the only ones considered as being qualified. Hence, subject(s) where there are 50% and above teachers who were holders of degree in science education were considered as having qualified teachers. The result is presented in Table 1.

Table 1: Qualification of science teachers in senior secondary schools

Science Teachers' Qualification	Science subjects						Total	
	Physics		Chemistry		Biology		f	%
	F	%	F	%	f	%		
NCE	13	15.8	3	3.8	4	5.2	20	8.2
Degree in Science Education	19	23.7	44	53.8	51	62.3	114	46.9
Degree in Science without Education		-	26	32.5	20	24.7	46	18.9
HND in Science Related Course	49	60.5	8	10.0	6	7.8	63	25.9
Total	81	100.0	81	100.0	81	100.0	243	100.0

Table 1 presents the qualifications of teachers teaching science subjects in senior secondary schools. The result reveals that 20 science teachers representing 8.2% of the total had NCE, 114(46.9%) were holders of Degree in Science Education, 46(18.9%) had Degree in Science without Education while 63(25.9%) were holders of HND in science related courses. Distribution of the science teachers based on area of specialization indicates that; majority, 49(60.5%) of Physics teachers had HND in science related courses while 13(15.8%) and 19(23.7%) had NCE and Degree in Science Education respectively. This implies that majority of the physics teachers are not qualified. Regarding the qualifications of Chemistry teachers, 44(53.8%) had Degree in Science Education, 26(32.5%) were holders of Degree in science without education, 8(10%) had HND in science related course while only 3(3.8%) had NCE. Similarly, 51(62.3%) of the Biology teachers had Degree in Science Education, 20(24.7%) had Degree in Science without Education, 6(7.8%) had HND in science related course while 4(5.2%) were NCE holders. The result from Chemistry and Biology teachers showed that majority of them are qualified contrary to the result from Physics teachers. A cursory look at the result in general, shows that less than half; 114(46.9%) of the science teachers possessed Degree in Science Education while 129(53.1%) had below the minimum required standard for teaching science subjects. This implies that most of the teachers teaching science subjects (particularly Physics) in senior secondary schools are not qualified. The qualifications of teachers teaching science subjects in senior secondary schools are further depicted in Figure i.

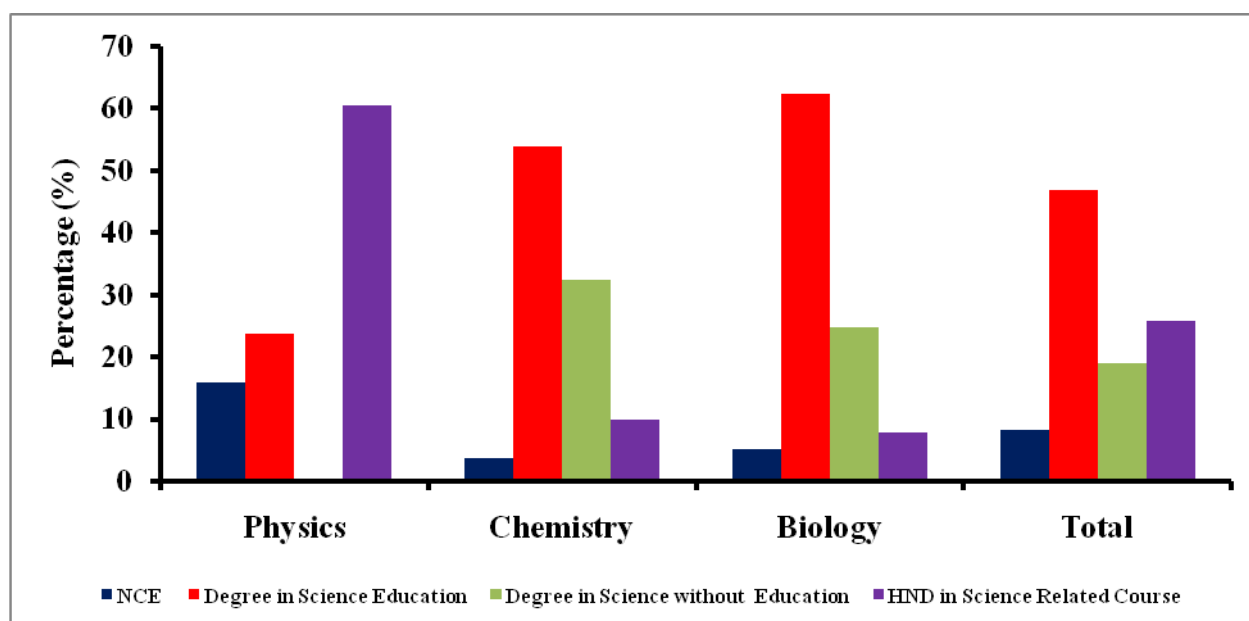


Figure i: Qualification of science teachers in Senior Secondary Schools

Research Question 2: How frequently do errors occur in science practical?

In order to answer the question, the grand mean of the total mean scores of the respondents were computed. Mean scores equal to or above the grand mean score were considered being frequent. The result is presented in Table 2.

Table 2: Frequency of errors in science practical

Errors Committed	Very Frequent		Frequent		Slightly Frequent		Not Frequent		Mean	Remark
	F	%	f	%	f	%	f	%		
Personal Errors	52	21.4	78	32.1	74	30.5	39	16	2.59	F
Environmental Errors	14	5.8	33	13.6	97	39.9	99	40.7	1.85	NF
Instrumental Errors	65	26.9	52	21.5	78	32.2	47	19.4	2.56	F
Observation Errors	41	16.9	81	33.3	84	34.6	37	15.2	2.52	F
Systematic Errors	35	14.4	69	28.4	89	36.6	50	20.6	2.37	F
Random Error	34	14.4	69	29.4	64	27.3	68	29	2.31	NF
Calculation Error	37	15.2	63	25.9	79	32.6	64	26.3	2.30	NF
Graph Errors	38	15.6	63	25.9	88	36.2	54	22.3	2.33	F

Error in Drawing	38	15.6	64	26.3	77	31.7	64	26.4	2.32	F
Gender Errors	15	6.2	60	24.7	79	32.5	89	36.6	2.01	NF
Average	37	15.2	63	26.1	81	33.4	62	25.3	2.32	

F = Frequent, NF = Not Frequent

Table 2 presents the frequency of occurrence of errors in science practical. Using a grand mean of 2.32 for the rating scale, the result shows that personal errors (mean=2.59), instrumental errors (mean=2.56), observation errors (mean=2.52), systematic errors (mean=2.37), graph errors (mean=2.33) and errors in drawing (mean=2.32) frequently occur in science practical while environmental errors (mean=1.85), random errors (mean=2.31), calculation errors (mean=2.30) and gender errors (mean=2.01) are less frequent. The result further reveals that 37(15.2%) of the total respondents indicate that error occurrence in science practical is very frequent, 63(26.1%) indicate 'frequent' while 81(33.4%) and 61(25.3%) indicate 'slightly frequent' and 'not frequent' respectively. This implies that frequency of occurrence of errors in science practical is moderate.

Research Question 3: In which of the three core fields of science (Physics, Chemistry and Biology) are errors most Frequent?

In answering the question, respondents' scores in each subject were categorized into two – Below 50% and above 50% of the total score on each of the errors in science practical. Scores equal to or above 50% of the total score were considered as being frequent errors in science practical. The result is presented in Table 3

Table 3: Frequency of error in the three core fields of science

Errors Committed	Physics		Chemistry		Biology	
	Below 50%	50% and above	Below 50%	50% and above	Below 50%	50% and above
Personal Errors	17(21.0)	64(79.0)*	9(11.1)	72(88.9)*	17(21.0)	64(79.0)*
Environmental Errors	46(56.8)	35(43.2)	54(66.6)	27(33.3)	32(39.5)	49(60.5)*
Instrumental Errors	11(13.0)	70(87.0)*	23(28.7)	58(71.3)*	13(15.8)	68(84.2)*
Observation Errors	16(19.5)	65(80.5)*	18(22.5)	63(77.5)*	19(23.7)	62(76.3)*
Systematic Errors	20(24.7)	61(75.3)*	16(19.8)	65(80.2)*	31(39.5)	50(60.5)*
Random Error	15(18.2)	66(81.8)*	17(21.0)	64(79.0)*	41(50.6)	40(49.4)
Calculation error	22(27.3)	59(72.7)*	11(13.6)	70(86.4)*	47(58.0)	34(42.0)
Graph Errors	17(21.0)	64(79.0)*	21(26.0)	60(74.0)*	36(44.4)	45(55.6)*
Error in Drawing	28(34.6)	53(65.4)*	20(24.7)	61(75.3)*	34(42.0)	42(58.0)*
Gender Errors	28(34.6)	53(65.4)*	41(50.6)	40(49.4)	40(49.4)	41(50.6)*
Average	22(27.2)	59(72.8)	23(28.4)	58(71.6)	31(38.3)	50(61.7)

* = Frequent errors, Percentage responses are enclosed in parentheses

Table 3 presents the errors that are frequent during science practical. The result reveals that all the errors are frequent during Physics practical except environmental errors. In Chemistry practical, errors such as personal, instrumental, observation, systematic, random, calculation, graph and drawing errors are frequent except environmental and gender errors. As regards Biology practical, nearly all the errors are frequent except random and calculation errors. However, errors in science practical are most frequent in Physics practical.

Discussion

Distribution of the science teachers based on area of specialization indicated that Physics was mostly affected by shortage of science teachers as only 23.7% of the teachers had degree in science education. In general, the result showed that most of the teachers teaching science subjects in senior secondary schools were not qualified. 20 science teachers representing 8.3% of the total had NCE, 114(46.9%) were holders of Degree in Science Education, 46(18.9%) had Degree in Science without Education while 63(25.9%) were holders of HND in science related course. It was found that less than half; 114(46.9%) of the science teachers possessed Degree in Science Education while 129(53.1%) had below the minimum required standard for teaching science subjects. In spite of the laudable effect of science practical to science teaching and learning, many teachers are not usually committed to engaging students with regular practical activities. This shortcoming is in agreement to the finding of this study that most of the teachers are not qualified to teach science subjects. Fatoba (2009) and Chelo (2010) agreed that some teachers teaching science subjects are not qualified. There must be adequate and appropriate flow of knowledge from teacher to students (Bande, 2008). One of the ways this could be possible is through a qualified teacher. This corroborates the observation of Adetayo in Bello (2015) that teachers' use of available instructional materials or laboratory equipments depend significantly on their qualifications.

The study revealed that frequency of occurrence of errors in science practical was moderate. It was found that personal errors, instrumental errors, observation errors, systematic errors, graph errors and errors in drawing were the most frequently occurred errors in science practical while environmental errors, random errors, calculation errors and gender errors occurred less frequently. This could be part of the reasons why Owolabi (2007) affirmed that errors can be traced to how apparatus are being handled, the method of observing and recording among others. In the same vein, some researchers affirmed that most of the equipments for science practical activities in schools are grossly inadequate which could be part of the reasons for committing various degrees of errors (Ihuorlam, 2008 and Aina, 2013).

The study showed that errors in science practical were most frequent in Physics practical. This is not surprising as the distribution of the science teachers based on area of specialization indicated that Physics was mostly affected by science teachers' shortage as only few of the teachers had degree in science education. The findings of Fatoba (2009) on the

relationship between teachers' educational qualification and students' performance confirmed that students who learn under professional, qualified and competent teachers perform excellently better than those who learn under non-qualified teachers. However, this contradicts the assertions of Makinde and Tom-Lawyer in Fakeye (2012) that there is no significant relationship between student's academic achievement and teachers' qualification and experience. The assertion of Makinde and Tom-Lawyer could be far from the truth because, in the researchers' opinion, the quality of education is directly related to the quality of teaching and learning. This corroborates the submission of Wilson, Floden and Ferrini-Mundy (2013) that, fully prepared and certified teachers are more successful with students than teachers who are not certified. In the same vein, Aina and Olanipekun (2015) affirmed that a qualified teacher is crucial to any educational system.

Conclusion

Based on the findings of this study, it could be concluded that large percentage of teachers teaching science subjects (particularly physics) in senior secondary schools were not qualified with its negative effect on the teaching and learning of science subjects. It could also be concluded that there were relationships between teachers' qualification and errors committed by students in science practical.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Government should embark on massive recruitment of qualified and experienced science teachers (particularly physics teachers) into the teaching service especially at the senior secondary school levels in order to reduce various degrees of errors committed by science students during practical and ensure accuracy of results of laboratory experiments in science subjects.
2. The education stakeholders such as the Government, NGOs, philanthropists, school administrators and parents should show greater commitment to the provision of well-equipped science laboratories in senior secondary schools for better teaching of science practical.
3. The Government in conjunction with the State Ministry of Education should encourage in-service training for science teachers for professional upgrading and competencies in their jobs. This could help the teachers to be more committed to practical oriented method of teaching and reduce the rate of errors committed by students during practical.

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