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Teachers' Characteristics and Science Teachers' Classroom Behaviour: Evidence From Science Classroom Surveys

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The major purpose of this study was to find out if there is any influence of teachers' characteristics on science teacher's classroom behaviours and determine the kind of relationship between teachers' characteristics and classroom behaviours. To guide this study, five research questions and hypotheses were raised, stated, answered, and tested at the significance level of 0.05. The design of case study is using an observational schedule called SCIC (science classroom interaction categories). The sample of the study consisted of 150 science teachers drawn from the 25 local government areas in Delta State. The data collected were analyzed with *t*-test, ANOVA (analysis of variance), and Pearson product moment correlation. The major findings of the study indicated: a significant difference in classroom behaviour scores among teachers with 0–5, 6–10, and 11 and above years of experience and a perfect correlation between years of experience and classroom behaviour; a significant higher classroom behaviour scores of male teachers over the females; a significant higher classroom behaviour scores of B.Sc. (Ed.) certificate holders over those with NCE (Nigeria Certificate of Education) and B.Sc. certificates; and a non-significant correlation between type of certificates and classroom behaviours. It was concluded that the five key behaviours studied remain the skeleton for effective science teaching and learning.

Keywords: teacher, science, behaviour, characteristics, classroom

Introduction

Background of the Study

The literature on the meaning of effective science teaching is not definitive (Ajaja, 2009a). Findings from literature indicate a failure of science education researchers to clearly define effective science teaching despite several decades of research in the field and attributed it to the failure to observe teaching activities. Ajaja (2009b) noted that what is found in literature as the meaning of effective science teaching is a broad characteristics of effective science teaching which varies to some extent from one author to another.

The history of an effective teacher has been evolving since the past 100 years. An effective teacher in the past was: a good person—a role model who met community ideal for a good citizen, good parent, and good employee (Borich, 2004, p. 3). At that time, teachers were judged primarily on their goodness as people and only secondarily on their behaviour in the classroom. In the past three decades, a revolution in the definition of good teachers on the bases of community ideals has proved very unrealistic. The revolution changed research in

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the field focus on the impact of specific cognitive and affective behaviours of their students. The term of good teaching changed to effective teaching, and the research focus shifted from exclusively studying teachers to include their effects on students (Borich, 2004). Using Borich's (2004) identified five key behaviours essential for effective teaching, effective science teaching may be defined as the teaching which demonstrates lesson clarity, instructional variety, teachers' task orientation, engagement in the learning process, and students' success rate. In essence, effective science teachers are persons who combine teaching skills with an active belief that instruction can make a difference in science learning. Effective science teaching is largely decision-making: The application of principles is drawn from the study of learning, motivation, development, and teaching (Ajaja, 2009, p. 147).

Teachers' characteristics in science education are most widely studied under six headings which include personality, attitudes, experience, aptitude/achievement, gender (sex), and training as measured by the certificate obtained. All these characteristics have many other sub-characteristics under them. Efforts are made in understanding the roles that these characteristics play in teaching and learning because of the critical role science teachers play in science curriculum implementation. It has been noticed that the single most important factor that can affect students' achievement is the teachers.

Science teachers can have a major influence on the way science students learn and develop. Science teachers who have an impact on students' lives are those who have a genuine interest in students, know their subject matter and possess detailed information about instructional processes and the way students learn and develop.

Among all other teachers' tasks in curriculum implementation is teaching which is intended to stimulate learning (Emeruwa, 1985). The teachers' guidance of students in the process of teaching takes many forms with equally many kinds of learning outcomes. These other directions include the awareness of the student of what he is to learn, the extent of measurement and the extent of feedback. These factors are closely related and they work together to influence or affect learning. Teachers have to bear this in mind, as they plan and implement the curriculum. Teachers of varying characters will implement the curriculum differently either to the benefit or detriment of the learner. It, therefore, follows that studies on the influence of teachers' characteristics on curriculum implementation are very important and strategic.

This study was propelled by the scanty literature in the field of teachers' characteristics particularly, as they influence science teachers' classroom behaviour. The bulk of literature on teachers' characters are from studies carried out in Europe, America and Asia are concentrated on their effects on achievements which are in the cognitive domain leaving classroom behaviour in the affective domain. There is really a dearth of sound knowledge of how teachers' characteristics influence teachers' classroom behaviours. This study is an attempt to reduce the imbalance in research efforts directed at the knowledge of the relationship between teachers' characteristics and classroom behaviours and is therefore very timely. Research efforts in this area are most important now because many important decisions which students make such as friends, subject, and career choices, are strongly bound up with their behaviours and attitudes (Ajaja, 2008).

From research, approximately 10 teachers' behaviours have shown promising relationships to desirable students' performance, primarily measured by classroom assessments and standardized tests (Borich, 2004, p. 11). Five of these behaviours have been consistently supported by research studies over the past 30 years (Brophy, 2002; Taylor, Pearson, Clark, & Walpole, 1999; Teddlie & Stringfield, 1993; Walberg, 1986). These key behaviours include lesson clarity, instructional variety, teachers' task orientation, engagement in learning process, and students' success rate.

Research on lesson clarity, which is one of the key behaviours, indicates that teachers vary considerably on this behaviour (Borich, 2004). It is observed that not all teachers are able to communicate clearly and directly to their subjects without wandering, speaking above students' levels of comprehension, or using speech patterns that impair their presentations clarity (Cruickshank & Metcalf, 1994; Brown & Wragg, 1993; Wilen, 1991). If a lesson is clearly presented, the teacher will spend less time going over materials and questions will be answered correctly at the first time, allowing more time for instruction. Research shows that oral clarity of presentations varies substantially among teachers and this in turn produces differences in students' performance on cognitive tests of achievement (Marx & Walsh, 1988; Borich, 2004).

Another key behaviour is identified as variability or flexibility of delivery during the presentation of a lesson (Borich, 2004; Brophy & Good, 1986). Literature indicates that different types of questions can be integrated into pacing and sequencing of a lesson to create meaningful variation (Chuska, 1995; Wilen, 1991). The most obvious aspect of variety in teaching is the use of learning materials, equipments, displays, and space in the classroom (Borich, 2004).

Continuing, Borich (2004) noted that the physical texture and visual variety of the classroom can contribute to instructional variety and in turn influence students' achievement. Some studies have found that amount of disruptive behaviour to be less in classrooms that had more varied activities and materials (Emmer, Evertson, & Worsham, 2003; Evertson, Emmer, & Worsham, 2003). Study by Lysakowski and Walberg (1981) found instructional variety to be related to students' attention.

The key behaviour which refers to how much classroom time the teacher devotes to the task of teaching an academic subject is referred to as teachers' task orientation. Studies on teachers' task orientation show that classrooms in which teacher-student interactions focus more on intellectual content that allows their students the maximum opportunity to learn and practice what was taught are more likely to have higher rates of achievement (Brophy, 2002; Berliner & Biddle, 1995; Porter, 1993).

One of the most recently researched teachers' behaviours related to students' performance is students' engagement in learning process. It is a key behaviour that refers to the amount of time that students devote to learning an academic subject. Some authors (Meichenbaum & Biemiller, 1998; Evertson, 1995; Tauber, 1990) made some useful suggestions on how to increase learning time and more importantly, students' engagement during learning. These suggestions include: set rules that let pupils attend to their personal and procedural needs; move around the room to monitor pupils seatwork, ensure that independent assignments are interesting, worthwhile, easy enough to be completed by each pupil; minimize time-consuming activities, make abundant use of resources and activities that are at or slightly above students' current level of understanding, and avoid timing error by stopping misbehaviour promptly. The application of all these in small groups and independent seatwork has been found to be beneficial (Anderson, Stevens, Prawat, & Nickerson, 1988).

The last of the key of effective teaching behaviours is students' success rate. Students' success rate refers to the rate at which the students understand and correctly complete exercises and assignments (Borich, 2004). There are three categories of success rates: (1) High success: The student understands the task and makes only occasional careless errors; (2) Moderate success: The student has partial understanding but makes some substantive errors; and (3) Low success: The student does not understand the task at all. Good and Brophy (2000) and Karweit and Slavin (1981) found that the time that the learner is actively engaged with thinking about and working with the content being taught was closely related to student success rate. Research as noted by Slavin (1991b) has shown that instruction promoting low error rates (high success) can contribute to increased levels of students' self-esteem and to positive attitude towards the subject matter and the school.

Correlational studies on the relationship between teachers' characteristics, teachers' behaviour, and students' outcomes in science are infrequent as found from literature in the field. However, the study by Druva and Anderson (1983) using the principle of meta-analysis of research, that focused on science teachers' characteristics is a significant and outstanding contribution towards the knowledge of how teachers' characteristics influence teachers' classroom behaviour and students' outcomes. The study correlated with teachers characteristics of gender, course work, IQ (intelligence quotient), and so forth with teaching behaviour in the classroom, such as questioning behaviour and teaching orientation; and student outcome characteristics, such as achievement and attitudes towards science. The subjects used for the study were selected from the entire United States.

With respect to the relationship between teachers' characteristics and teacher behaviour as reported by Trowbridge and Bybee (1996), the following outcomes emerged:

(1) Teaching effectiveness is positively related to training and experience as evidenced by the number of educational courses, student-teaching grade, and teaching experience;

(2) Teachers with more positive attitudes toward the curriculum that they are teaching tend to be those with a higher grade-point average and more teaching experience;

(3) Better classroom discipline is associated with teacher characteristics of restraint and reflectivity;

(4) Higher level, more complex questions are employed more often by teachers with greater knowledge and less experience in teaching.

Later, researches on the effect of teacher characteristics on effective teaching behaviours and using students' points of view found that teacher-expressive characteristics, such as warmth, enthusiasm, and extroversion apparently separate effective from ineffective teachers (Radmacher & Martin, 2001; Basow, 2000; Best & Addison, 2000).

From the foregoing, attempts have been made by the researchers to define effective science teaching. In the process, five key behaviours of effective teaching were discussed and their effects on students' learning well stated. The relationship between teachers' characteristics and science teachers' classroom behaviours were x-rayed in spite of the dearth of literature in the area. Specifically, this study attempts to relate selected teachers' characteristics (experience, training, and sex) with science teachers' classroom behaviours. This study will contribute mainly in improving our knowledge about the influence of teachers' characteristics on science teaching and learning. The study taken singly will contribute to increasing the volume of literature in the field.

Statement of the Problem

This study was in part driven by the fact that classroom practices which contribute to effective teaching are influenced by teachers' characteristics which then impact on pupils' motivation, achievement, and attitude toward learning. That is to say, for teachers having been equipped with pedagogical and professional training would not be enough to establish a positive, learnable, and teachable classroom climate. Specifically, the factors that best facilitate students' learning are considered to be the ones that are described as being purposeful, task-oriented, relaxed, warm, supportive and have a sense of order and humour in an integrated sense (Kumaravadivelu, 1992). These characteristics are provided by teachers. The second reason which propelled the study was the scarcity of literature directed at classroom behaviour in the field. This therefore implies that our knowledge of how science teachers' characteristics influence classroom activities may have been limited, inaccurate, and inconclusive. The situation, therefore, calls for more research in the field for the purpose of improving science teaching and learning.

The statement of the problem therefore is: Will the determination of the relationship between selected science teachers' characteristics (experience, sex, and training) and classroom behaviours generate information that could be used to improve science teaching and learning?

Research Questions

To guide this study, the following research questions were raised and answered:

(1) Is there any difference in science teachers' classroom behaviours among teachers with 0–5, 6–10, and 11 and above years of experience?

(2) Is there any difference in science teachers' classroom behaviours between male and female science teachers?

(3) Is there any difference in science teachers' behaviour among teachers with NCE (Nigeria Certificate of Education), B.Sc. (Ed.), and B.Sc. certificates?

(4) Is there any correlation between teachers' years of experience and science teachers' classroom behaviours?

(5) Is there any correlation between types of certificates possessed by teachers and their classroom behaviours?

Research Hypotheses

To further direct this study, five hypotheses were stated and tested at the significance level of 0.05.

Ho_1: There is no significant difference in science teachers' classroom behaviours among science teachers with 0–5, 6–10, and 11 and above years of experience;

Ho_2: There is no significant correlation between teachers' years of experience and science teachers' classroom behaviours;

Ho_3: There is no significant difference in classroom behaviours between male and female science teachers;

Ho_4: There is no significant difference in science teachers' behaviour among teachers with NCE, B.Sc. (Ed.) and B.Sc. certificates;

Ho_5: There is no significant correlation between types of certificate possessed by teachers and their classroom behaviours.

Methodology

The Design of the Study

The design employed for the study was case study. In case studies, researchers only observe the characteristics of individual units of research interest. The goal of observation in case study is to study the characteristics and functional pattern of the subjects and from there make broad generalizations to the large population. In this study, characteristics of individual units of interest were: teachers' classroom behaviours, as influenced by science teachers' years of experience, training, and sex.

The pattern of observation of the construct was the adoption of the non-participant approach. During the science lessons in the selected schools and selected classes, the researchers and research assistants merely coded the behaviour patterns of the science teachers as the lessons went on. The researchers and the research assistants were not part of the events and activities studied. This description agrees with Leedy and Ormrod's (2005) and Johnson and Christensen's (2000) explanation of non-participant observation.

The Sample of the Study

The sample of the study consisted of 50 public secondary schools drawn from the three Senatorial Districts in Delta State. Delta State is divided into three Senatorial Districts which consist of Delta North, Delta South, and Delta Central. The state is made up of 25 local government areas in which there are 381 public senior secondary schools. The sample of the science teachers was 150, which consisted of 50 biology, chemistry, and physics teachers each.

The procedure for sampling was purposive random sampling. The variables which guided the sampling included science teachers' characteristics such as: years of experience, training, and sex. The list of senior secondary schools from where the characteristics of science teachers in the public secondary schools were derived was collected from the PPB (Post Primary Board) at Asaba. With this list, all the public senior secondary schools with the characteristics of interest were identified and separated from others. Using balloting, that is withdrawal with replacement; two senior secondary schools were selected from each of the 25 local government areas in Delta State.

Instruments

One instrument was used for data collection and it is a behaviour checklist. The science teachers' classroom behaviour checklist was constructed by the researcher by adapting the characteristics of behaviours identified by Borich (2004). The instrument was called SCIC (science classroom interaction categories). The checklist is an observational instrument designed specifically for use in science classrooms in assessing teachers' behaviours during teaching (see Appendix 1). Observers using the SCIC are to rate science teachers on an 8-point scale of Stanford teachers' competence appraisal guide (see Table 1).

Table 1

An 8-Point Scale of Stanford Teachers' Competence Appraisal Guide

0	UO (Unable to observe)
4	SJ (Strong)
1	W (Weak)
5	SU (Superior)
2	BA (Below average)
6	OS (Outstanding)
3	A (Average)
7	TE (Truly exceptional)

Note. Source: Trowbridge and Bybee (1996), in teaching secondary school science.

The ratings of all the items are totaled for a cumulative score for each category and for all categories.

The SCIC consists of Sections A and B.

Section A is designed to collected demographic information on sex, years of experience, and certificate obtained. Section B consists of 28 items which clustered under five categories (lesson clarity, instructional variety, teachers' task orientation and engagement in learning process, and students' success rate).

The validity of the instrument was determined by jury of five judges which consisted of three specialists in science education (biology, chemistry, and physics), one experienced science teacher, and one expert in measurement and evaluation. They confirmed the ability of the instrument to generate data to answer the research questions and test the stated hypotheses. After a few corrections based on their comments which the instrument was used. In fact, they determined the content validity of the instrument.

The reliability of the science teachers' classroom interaction categories was determined using Cronbach's alpha technique. This decision agreed with Wiseman's (1999) stand and recommendation that when the scoring of items on a test is not limited to 1 point (for correct) or 0 point (for incorrect) response, Cronbach's alpha would be appropriate. To this end, 20 science teachers who were not part of the study were observed with SCIC and the ratings obtained subjected to Cronbach alpha formula.

The Alpha value obtained for SCIC was 0.78. This value obtained fell in line with the recommendation of Leedy and Ormrod (2005), Borich (2004), Johnson and Christensen (2000), Wiseman (1999), and Thorndike and Hagen (1997) that any instrument with a reliability index of 0.7 and above is adjudged as being reliable. Based on the obtained reliability index for the instrument, it was used for data collection because it was found to be reliable.

Procedure for Data Collection

The collection of data was done by a team of 11 persons made of the two researchers and nine research assistants. The research assistants were selected based on their knowledge of the environments of the selected schools. To this end, three research assistants were selected from each of the senatorial districts.

The first step in the collection of data was the training of the research assistants. This was done by the researchers and it lasted for just one day. During the training session, the researchers together with the research assistants went through all the items in the instrument. On the use of the SCIC, the research assistants were specifically told what to code and where to code. They were told to observe all the science teachers in their groups from the beginning of the lesson to the end.

To collect the data, copies of the observational instrument were shared among the nine research assistants based on the projected number of subjects which were selected in the various senatorial districts. During the observation of the science teachers with the SCIC, one science teacher was observed per day per subject from the beginning of the lesson to the end. This was done to allow a thorough observation to be made. In all, six days were spent on data collection with each research assistant spending one day in each school. During the period of data collection, the researchers moved from one senatorial district to the other and monitored what the research assistants were doing in the selected schools. This enabled the researchers to solve immediate problems like uncooperative attitude of science teachers and their students and transport difficulties peculiar with the various zones.

On the seventh day, all the research assistants and the researchers met to appraise the entire exercise. In the meeting, the researchers collected all the instruments shared to each of the research assistants. All the rated checklists were scored and summarized in Tables 3−12 as shown under results to answer the research questions raised and test the hypothesis stated. The teachers' characteristics variables categorized under various levels, were given numerical values for the purpose of differentiation. The values are as shown in Table 2.

Table 2

Teachers' Characteristics Variables Key by Sex, Certificate, and Years of Experience

Category	Level
Sex	Male: 1
	Female: 2
Training (measured by certificate possessed)	NCE: 1
	B.Sc.: 2
	B.Sc. (Ed.): 3
Years of experience	0–5 years: 1
	6–10 years: 2
	11 and above: 3

The stated hypotheses were tested with Pearson product moment correlation, students' *t*-test and ANOVA (analysis of variance) statistics.

Results and Discussion

Results

As shown in Table 3, the mean scores on science teachers' classroom behaviours for every type of behaviour increased with years of experience. Table 3 shows that science teachers with 11 and above years of experience had the highest behaviour scores among science teachers with 0–5, 6–10, and 11 and above years of experience.

Table 3

Descriptive Statistics Comparing Science Teachers With 0–5, 6–10, and 11 and Above Years of Experience on Classroom Behaviours

Bevahiour		*N*	Range	Minimum	Maximum	Mean	Std. deviation
0−5 years of experience	Lesson clarity	75	19.00	9.00	28.00	17.2800	4.92802
	Instructional variety	75	22.00	7.00	29.00	17.4667	4.95475
	Teachers' task orientation	75	15.00	11.00	26.00	17.9067	3.96325
	Engagement in learning process	75	14.00	5.00	19.00	11.2533	3.66537
	Students' success rate	75	17.00	8.00	25.00	16.600	4.96746
6−10 years of experience	Lesson clarity	46	5.00	22.00	27.00	24.8261	1.67736
	Instructional variety	46	8.00	21.00	29.00	24.2826	2.95645
	Teachers' task orientation	46	9.00	20.00	29.00	24.1957	2.49105
	Engagement in learning process	46	10.00	9.00	19.00	12.5217	2.82638
	Students' success rate	46	16.00	15.00	31.00	22.3696	5.14828
11 and above years of experience	Lesson clarity	29	12.00	22.00	34.00	26.8966	3.74495
	Instructional variety	29	8.00	23.00	31.00	27.0000	2.23607
	Teachers' task orientation	29	7.00	21.00	28.00	25.1379	2.34100
	Engagement in learning process	29	13.00	10.00	23.00	14.6552	4.37751
	Students' success rate	29	15.00	14.00	29.00	21.6897	4.92880

Table 4 which shows the ANOVA comparison of classroom behaviour scores of science teachers with 0–5, 6–10, and 11 and above years of experience indicates that the calculated F is 256.3843 and is higher than the critical F of 3.0576. With this result, Ho_1 was rejected ($F = 256.3843$, $p < 0.05$), because there was a significant difference in behaviour scores among science teachers with 0–5, 6–10, and 11 and above years of experience.

Table 4

ANOVA Summary Table Comparing Teachers With 0–5, 6–10, and 11 and Above Years of Experience on Classroom Behaviour

Source of variation	*SS*	*df*	*MS*	*F*	*p*-value	*F*-crit.
Between groups	777,408	2	388,704	256.38704	1.18E-48	3.057622
Within groups	222,866.6	147	1,516.099			
Total	1000,275	149				

Table 5

Correlation Between Years of Experience and Science Teachers' Classroom Behaviours

		1	2	3
	Pearson correlation	1	0.997**	0.999**
1	Sig. (2-tailed)		0.000	0.000
	N	75	46	29
	Pearson correlation	0.999**	1	1.000**
2	Sig. (2-tailed)	0.000		0.000
	N	29	46	29
	Pearson correlation	0.999**	1.000**	1
3	Sig. (2-tailed)	0.000	0.000	
	N	29	29	29

Table 6

Descriptive Statistics Comparing Male & Female Science Teachers on Classroom Behaviours

Bevahiour		*N*	Range	Minimum	Maximum	Mean	Std. deviation
	Lesson clarity	92	22.00	11.00	33.00	22.0978	6.07654
	Instructional variety	92	17.00	14.00	31.00	21.6957	5.43440
Male	Teachers' task orientation	92	16.00	13.00	29.00	21.6848	4.48668
	Engagement in learning process	92	15.00	7.00	22.00	13.2717	4.41303
	Students' success rate	92	20.00	11.00	31.00	18.8587	6.19922
	Lesson clarity	59	24.00	9.00	33.00	20.9153	6.90649
	Instructional variety	59	22.00	7.00	29.00	21.2203	6.57600
Female	Teachers' task orientation	59	15.00	11.00	26.00	20.2881	4.98636
	Engagement in learning process	59	10.00	5.00	15.00	10.3559	2.42660
	Students' success rate	59	20.00	8.00	28.00	19.5254	5.58124

Table 5 which shows the kind of relationship between years of experience and classroom behaviours indicates that the calculated *r* of 0.997, 0.999, and 1.000 is higher than the critical *r* of 0.1946. With this result, Ho_2 was also rejected because there is a significant correlation between years of experience and science teachers' classroom behaviours. The calculated *r* as shown in Table 5 indicates a perfect correlation.

As shown in Table 6, the mean scores on classroom behaviours of male and female science teachers on each item of the classroom behaviours fell within a close range. Table 6 shows that the male science teachers outscored the females in four of the items while the female science teachers outscored the males in only one of the items.

Table 7

T-test Comparison of Male and Female Science Teachers on Classroom Behaviours

	Mean	*N*	Std. deviation	*df*	*t*	*t*-critical two tail at 0.05
Male	97.6087	92	22.667	91	6.7264	1.9863
Female	59.1957	92	48.449			

Table 7 which shows the *t*-test comparison of the male and female science teachers on classroom behaviours indicates a significant difference between male and female science teachers. As shown in Table 7, the calculated *t* of 6.7264 is greater than the critical *t* of 1.9863. With this result Ho_3 was rejected ($t = 6.7264$, $p < 0.05$).

Table 8

Descriptive Statistics Comparing NCE, B.Sc. (Ed.), and B.Sc. Certificate Holders on Classroom Behaviours

Behaviour		*N*	Range	Minimum	Maximum	Mean	Std. deviation
NCE	Lesson clarity	29	18.00	9.00	27.00	19.2759	7.51616
	Instructional variety	29	14.00	15.00	29.00	22.8621	5.42299
	Teachers' taskorientation	29	10.00	14.00	24.00	20.0000	3.76070
	Engagement in learning process	29	5.00	9.00	14.00	10.3793	1.34732
	Students' success rate	29	19.00	10.00	29.00	18.1724	5.88017
B.Sc. (Ed.)	Lesson clarity	75	16.00	17.00	33.00	25.6000	4.25854
	Instructional variety	75	13.00	17.00	30.00	24.4933	4.02483
	Teachers' task orientation	75	13.00	16.00	29.00	24.3867	3.33245
	Engagement in learning process	75	17.00	5.00	22.00	13.8533	4.28603
	Students' success rate	75	18.00	13.00	31.00	21.9067	5.09418
B.Sc.	Lesson clarity	46	16.00	12.00	28.00	17.3043	4.94804
	Instructional variety	46	18.00	7.00	25.00	15.9130	5.21888
	Teachers' task orientation	46	12.00	11.00	23.00	17.3043	3.52685
	Engagement in learning process	46	12.00	12.00	19.00	10.7391	3.75017
	Students' success rate	46	16.00	8.00	24.00	14.6522	5.00763

Table 8 compares the classroom behaviours of science teachers with NCE, B.Sc. (Ed.), and B.Sc. certificates and shows that science teachers with B.Sc. (Ed.) certificate have the highest behaviour scores in all the items under the classroom behaviours. This is followed by the NCE certificate holders, while the science teachers with B.Sc. certificate have the least mean scores on classroom behaviours.

Table 9

ANOVA Summary Table Comparing of Science Teachers With NCE, B.Sc. (Ed.), and B.Sc. Certificate Holders on Classroom Behaviours

Source of variation	Sum of squares	*df*	Mean square	F	*F*-critical at 0.05	Sum of squares
Between groups	34,585.8	2	17,292.9	53.1972	4.2E-18	3.05762
Within groups	47,785.5	147	325.072			
Total	82,371.3	149				

Table 9 which shows the ANOVA comparison of science teachers with NCE, B.Sc. (Ed.), and B.Sc.

certificates on classroom behaviours indicates that the calculated *F* of 53.1972 is greater than the critical *F* value of 3.0576. With this result, Ho_4 was rejected ($F = 53.1972$, $p < 0.05$).

Table 10

ANOVA Summary Table Comparing Individual Teachers With NCE, B.Sc. (Ed.), and B.Sc. on Classroom Behaviours

		Sum of squares	*df*	Mean square	*F*	*F*-critical at 0.05
NCE	Between groups	12,385.707	27	458.730	0.842	
	Within groups	544.500	1	544.500		
	Total	12,930.207	28			
B.Sc. (Ed.)	Between groups	6,573.793	27	243.474	0.304	2.796
	Within groups	800.00	1	800.000		
	Total	7,373.793	28			
B.Sc.	Between groups	9,360.534	27	346.686	14.150*	
	Within groups	24.500	1	24.500		
	Total	9,385.034	28			

Note. * Significant at 0.05.

Table 10 which shows the ANOVA comparison of individual classroom behaviours scores within each of the certificate brackets (NCE, B.Sc. (Ed.), and B.Sc. (Ed.)) indicates that the calculated *F* values for NCE, B.Sc.(Ed.), and B.Sc. when compared the critical *F* of 2.796 established significant differences only among teachers with B.Sc.. Among science teachers with NCE and B.Sc. (Ed.) certificates, no significant differences were found among them on classroom behaviour scores.

To determine the direction of significance as found among NCE, B.Sc. (Ed.), and B.Sc. certificate holders as shown in Table 9 and in which Scheefe test is unable to do because of varying number of subjects in the various groups of certificate holders, *t*-test is employed to compare paired samples as shown in Table 11.

Table 11 shows significant differences among the three paired samples on classroom behaviour scores earned and followed this order: NCE *vs.* B.Sc. (Ed.), B.Sc. (Ed.) earned higher; NCE *vs.* B.Sc., NCE earned higher; and B.Sc. (Ed.) *vs.* B.Sc., B.Sc. (Ed.) earned higher.

Table 11

T-test Comparison of Paired Samples on Classroom Behaviour

	Mean	*N*	Std. deviation	*df*	*t*	*t*-critical at 0.05
Pair 1 NCE	90.6897	29	21.48	28	3.609*	2.048
B.Sc. (Ed.)	109.2759	29	16.23			
Pair 2 NCE	90.6897	29	21.48	28	3.302*	2.048
B.Sc.	74.4138	29	18.30			
Pair 3 B.Sc. (Ed.)	109.3478	46	15.75	45	8.396*	2.014
B.Sc.	75.91	46	19.0			

Note. * significant at 0.05.

As shown in Table 12, it is on the type of correlation between types of certificates and science teachers' classroom behaviours, Table 12 shows that the critical *r* of 0.1946 is greater than the calculated *r* of -0.063, 0.117, and -0.174 respectively. With this result Ho_5 was retained (r, $p \geq 0.05$). This means that there is no significant relationship between certificate and classroom behaviour.

Table 12

Correlation Between Types of Certificate and Science Teachers' Classroom Behaviours

		NCE	B.Sc. (Ed.)	B.Sc.	Critical value
	Pearson correlation	1	-0.063	0.117	
NCE	Sig. (2-tailed)		0.744	0.544	
	N	29	29	29	
	Pearson correlation	-0.063	1	-0.174	
B.Sc. (Ed.)	Sig. (2-tailed)	0.744		0.248	0.1946
	N	29	75	46	
	Pearson correlation	0.117	-0.174	1	
B.Sc.	Sig. (2-tailed)	0.544	0.248		
	N	29	46	46	

Discussion

The authors' experiences from supervision of practical teaching indicate that instructional failure in most classrooms is not essentially due to the use of inappropriate methods for instruction but to a great extent due to the exhibition of inappropriate classroom behaviours by teachers. The inappropriate behaviours that exhibited by teachers are known to influence their quality of instruction which directly affect their students' learning. Review of relevant literature in this area of teaching indicates a very serious dearth of well-researched information in the field. This study is, therefore, very timely and significant in the sense that it will increase the volume of literature in teachers' classroom behaviours and particularly how teachers' characteristics influence science teachers' classroom behaviours. The literature at our disposal indicates that the most significant study on the relationship between science teachers' characteristics and classroom behaviours was the one carried out by Druva and Anderson (1983), using the principle of meta-analysis of research. Although the study by Druva and Anderson (1983) among other teachers' characteristics correlated teachers' sex and experience with science teachers' classroom behaviours, this study went a step further to correlate the types of professional teaching certificates possessed by science teachers with their classroom behaviours. The findings of Druva and Anderson (1983) need to be updated to improve our knowledge of how science teachers' characteristics influence teachers' classroom behaviours in the recent times. That is what we have just done.

One finding of this study shows that science teachers' classroom behaviours on lesson clarity, instructional variety, teachers' task orientation, engagement in learning process, and students' success rate improved as the years of experience in teaching increased. This was shown in the significant difference in classroom behaviour scores found among teachers with 0–5, 6–10, and 11 and above years of experience in Table 4 with teachers with 11 and above years outscoring all other groups. This finding agreed with the finding of Druva and Anderson (1983) as reported by Trowbridge and Bybee (1996) that teaching effectiveness is measured by teacher's classroom behaviours in related to experience. The lower scores of science teacher with 0–5 years of experience on classroom behaviours may be explained with their limited familiarity and practice of the attributes of appropriate classroom behaviours taught them as students. The increase in the teachers' behaviours scores over experience may therefore be hinged in the acquisition of the appropriate skills and competencies on the exhibition of the required classroom behaviours. Ajaja (1998) working on the effect of experience among students using invention method on students' achievement, found that the initial low scores of students in the invention class were due to the unfamiliarity and difficulty of the learning task. Based on this argument, it may be inferred that the advantage enjoyed by the science teachers with 11 and above years over other categories of teachers in terms of behaviours scores was due to the over-learning of the rules of effective classroom behaviours which enabled them to overcome the initial setback experienced.

Again, finding of this study indicated a strong correlation between years of experience and classroom behaviour. The strength of correlation found was a perfect correlation. This implied that the higher the years of teaching experience the better the exhibition of appropriate science classroom behaviours. This finding agreed with the report of Trowbridge and Bybee (1996) that teaching effectiveness is positively related to experience. Still related to this finding are some studies on the effect of teachers' characteristics on effective teaching behaviours which found that teachers' expressive characteristics, such as warmth, enthusiasm, and extroversion derivable from experiences on the job apparently separate effective from ineffective teachers (Radmacher & Martin, 2001; Basow, 2000; Best & Addison, 2000).

Another finding of this study as shown in Table 7 indicated a significant difference in classroom behaviours of science teachers between males and females with males outscoring the females. Although the finding of Druva and Anderson (1983) as reported by Trowbridge and Bybee (1996) did not report any significant difference in classroom behaviour between male and female science teachers, their finding that student achievement is positively related to teacher characteristics of masculinity which tends to suggest that the exhibition of the effective classroom behaviours that the exhibition of the effective classroom behaviours to bring about effective learning by students may to some extent be hinged on the ability of the science teachers to exhibit masculine characteristics. This position tends to agree with the earlier impression by Kelly (1985) and Harding (1996) that science is dehumanized and that it is masculine in nature. Continuingly, Head and Ramsden (1990) noted that female scientists were likely to be realistic decision-makers who preferred to focus on facts which were organized and dependable like most men. The significant higher classroom behaviour scores of male teachers over the females may be explained with the direct comparison of the sample sizes of the male and female science teachers used in this study. The sample size of the male science teachers was 92 as against 59 of the females. The sample size of the male science teachers already portrayed the males as more inclined to science than the females. The more inclination of males to science has been reported by Linver, Davis-Kean, and Eccles (2002), Bennett (2003), and Chang and Yuan (2008). This inclination of more males to science than females may be responsible for the higher classroom behaviour scores of male science teachers than females in science classrooms. The varying number of male and female students studying science has been hinged on assigned sex roles by the society.

On how the types of certificates possessed by science teachers influence their classroom behaviours, a significant difference was found among NCE, B.Sc. (Ed.), and B.Sc. certificate holders as shown in Table 9. Science teachers with B.Sc. (Ed.) certificate outscored both the NCE and B.Sc. certificate holders. The *t*-test comparison of paired samples showed the direction of significance among the groups and established a trend in the exhibition of classroom behaviours. Teachers with B.Sc. (Ed.) outscored NCE and B.Sc. certificate holders, while NCE certificate holders outscored B.Sc. certificate holders. The noticed significant influence of the type of certificates on teachers' classroom behaviours agreed with the finding of Druva and Anderson (1983) as reported by Trowbridge and Bybee (1996) that teachers' classroom behaviour is positively related to training. The noticed significantly higher behaviour scores by science teachers with B.Sc. (Ed.) over those with NCE and B.Sc. certificates may be due to the fact that they took more teaching method courses than the NCE and B.Sc. certificate holders. It will take NCE certificates holders three academic sessions to obtain B.Sc. while

B.Sc. certificate holders have not taken any course on teaching method. They have no knowledge of teaching methods.

One striking finding emerged from this study as shown in Table 10 justifying the need for the acquisition of teaching methods for the exhibition of appropriate classroom behaviours. Table 10 shows that individual teachers with NCE and B.Sc. (Ed.) did not have significant differences among themselves in the exhibition of classroom behaviours. This development maybe explained the fact that the individual science teachers with NCE and B.Sc. (Ed.) certificates had similar skills and competencies in teaching methods appropriate for their programmes and so exhibited similar range of behaviours appropriate for their programmes. However, B.Sc. certificate holders, who took no courses in teaching methods, were significantly varied in their behaviour scores. The noticed significant variability among the B.Sc. certificate holders may be due to the lack of the knowledge and observation of the basic rules which required in instructional presentation. This may have resulted in the greatly varied classroom behaviours among them.

On correlation between the types of certificate possessed by science teachers and classroom behaviour, no significant relationship was found. This again agrees with the finding of Druva and Anderson (1983) as reported by Trowbridge and Bybee (1996). Druva and Anderson (1983) did not report any correlation between certificate possessed by science teachers and teachers' classroom behaviour, but they reported a positive relationship between a number of educational courses taken and classroom behaviours. This implies that the certificate types which on their own do not significantly influence classroom behaviour but the varying course contents taken before the certificates are awarded to determine the nature of classroom behaviours exhibited.

Conclusion

All the key behaviours investigated in this study are very important and essential for effective teaching and learning of science. After a very long break, this study has reawaken an almost forgotten field of study—teachers' characteristics and classroom behaviours. The five key behaviours: lesson clarity, instructional variety, teachers' task orientation, students' engagement, and success rate, are skeleton for the effective teacher to wear to enable him to teach effectively. Based on the findings on this study, the following conclusions are drawn:

(1) Since the finding of this study indicates a perfect correlation between teaching experience and exhibition of appropriate classroom behaviour, it is concluded that the training of teachers which emphasizes a very long period of training on classroom behaviour would enhance appropriate exhibition of classroom behaviours on graduation;

(2) Since more male science teachers than the females are in the field and they exhibit higher classroom behaviours, it is concluded that encouraging more females to study science will increase female science teachers and this will help to reduce the variation in classroom behaviours among teachers;

(3) Since the study found that science teachers with teaching qualifications (NCE and B.Sc. (Ed.)) outscored those without teaching qualification (B.Sc.), it is concluded that the educational courses on teaching methods significantly influence teachers' classroom behaviours. It, therefore, implies that only professionally trained teachers should be employed to teach in schools for students to learn well.

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Appendix 1

SCIC (Science classroom interaction)

The research work which calls for this checklist is purely academic in purpose and it is aimed at finding out classroom behaviours of science teachers to improve instruction in science subjects.

Instructions to observers

Fill in the spaces provided by writing.

During the lesson, score each of the items under the various categories based on how the behaviour was exhibited using the following values: 7 to "Truly exception (TE)", 6 to "Outstanding (OS)", 5 to "Superior (SU)", 4 to "Strong (ST)", 3 to "Average (A)", 2 to "Below average (BA)", 1 to "Weak (W)", and 0 to "Unable to observe (UO)".

Using the following scale (ties are allowed).

If the behaviour was the most dominant one, under each category mark 4.

If the behaviour was quite frequent, mark 3.

If the behaviour was infrequent, mark 2.

If the behaviour did not occur, mark 1.

Fill in the sheet without consulting anyone, and hand it immediately to the researchers.

Thanks for your cooperation.

Personal data

Name of school: ……………………………………………………………

Sex of teacher: ……………………………………………………………..

Qualification: ………………………………………………………......

Years of experience: …………………………………………………..

Subject taught: ……………………………………………………………

Behaviour category													
	Lesson clarity (being clear)	Checkmark rating								Frequency rating			
		0	1	2	3	4	5	6	7	1	2	3	4
1	Informs learners of the lesson objective (e.g., describes what behaviours will be tested or required on future assignments as a result of the lesson).												
2	Provides learners with an advance organizer (e.g., places lesson in perspective of past and/or future lessons).												
3	Checks for task-relevant prior learning at beginning of the lesson (e.g., determines level of understanding of prerequisites facts or concepts and reteaches, if necessary).												
4	Give directives slowly and distinctly (e.g., repeats directives when needed or divides them into smaller pieces).												
5	Knows ability levels and teaches at or slightly above learners' current level of understanding (e.g., knows learner's attention spans).												
6	Uses examples, illustrations, and demonstrations to explain and clarify (e.g., uses visuals to help interpret and reinforce main points).												
7	Provides review or summary at end of each lesson.												
	Instructional variety (using variety)	Checkmark rating								Frequency rating			
		0	1	2	3	4	5	6	7	1	2	3	4
1	Uses attention-gaining devices (e.g., begins with a challenging question, visual, or example).												
2	Shows enthusiasm and animation through variation in eye contact, voice, and gestures (e.g., changes pitch and volume, moves about during transitions to new activity).												
3	Varies mode of presentation (e.g., presents/asks questions, then provides for independent practice (daily)).												
4	Uses a mix of rewards and reinforcers (e.g., extra credit, verbal praise, independent study, etc. (weekly, monthly)).												
5	Incorporates student ideas or participation in some aspects of the instruction (e.g., uses indirect instruction or divergent questioning (weekly, monthly)).												
6	Varies types of questions (e.g., divergent, convergent, (weekly)) and probes (e.g., to clarify to solicit, to redirect (daily)).												
	Teachers' task orientation (being task oriented)	Checkmark rating								Frequency rating			
		0	1	2	3	4	5	6	7	1	2	3	4
1	Develops unit and lesson plans that reflect the most relevant features of the curriculum guide or adopted text (e.g., each unit and lesson objective can be referenced back to curriculum guide or text).												
2	Handles administrative and clerical interruptions efficiently (e.g., visitors, announcements, collection of money, dispensing materials, and supplies) by anticipating and pre-organizing some tasks and deferring others non-instructional time.												
3	Stops or prevents misbehaviour with a minimum or class disruption (e.g., has pre-established academic and work rules to "protect" intrusions into instructional time).												
4	Selects the most appropriate instructional model for the objectives being taught (e.g., primarily uses direct instruction for knowledge and comprehension objectives and indirect instruction for inquiry and problem-solving objectives).												
5	Builds to unit outcomes with clearly definable events (e.g., weekly and monthly review, feedback, and testing sessions).												

(Table continued)

	Engagement in the learning process (engaging students effectively)	Checkmark rating								Frequency rating			
		0	1	2	3	4	5	6	7	1	2	3	4
1	Elicits the desired behaviour immediately after the instructional stimuli (e.g., provides exercises or workbook problems with which the desired behaviour can be practiced).												
2	Provides opportunities for feedback in a nonevaluative atmosphere (e.g., asks students to respond as a group or covertly the first time through).												
3	Uses individual and group activities (e.g., performance contracts, CD-ROMs, games and simulations, and learning centers as motivation aids) when needed.												
4	Uses meaningful verbal praise to get and keep students actively participating in the learning process.												
5	Monitors seatwork and frequently checks progress during independent practice.												
	Student success rate (moderate-to-high rates of success)	Checkmark rating								Frequency rating			
		0	1	2	3	4	5	6	7	1	2	3	4
1	Establishes unit and lesson content that reflects prior learning (e.g., planning lesson sequences that consider task-relevant prior information).												
2	Administers corrective measures immediately after initial response (e.g., shows model of correct answer and how to attain it after first crude response is given).												
3	Divides instructional stimuli into small chunks (e.g., establishes bite-size lessons that can be easily digested by learners at their current level of functioning).												
4	Plans transitions to new material in easy to grasp steps (e.g., changes instructional stimuli according to pre established thematic pattern so that each new lesson is seen as an extension of previous lessons).												
5	Varies the pace at which stimuli are presented and continually builds toward a climax or key event.												

Note. Designed by the two authors adapting key behaviour characteristics identified by Borich (2004) in "Effective teaching methods" (5th ed.), using Stanford Teacher Competence Appraisal Guide Scale in Trowbridge and Bybee's (1996) "Teaching secondary school sciences: Strategies for developing scientific literacy".