Quest Journals
Journal of Research in Humanities and Social Science
Volume 3 ~ Issue 2 (2015) pp:50-55
ISSN(Online) : 2321-9467
www.questjournals.org

Research Paper

Pedagogical Practices in the Teaching of Science in Secondary Schools in Rivers State Nigeria

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ABSTRACT:- Studies in science classroom activities have often categorized teaching into simple dichotomous teaching methods or strategies which do not take into consideration the composite nature of teaching. This work sought to observe some pedagogical practices employed by science teachers in Rivers State and to compare science teachers' report of their classroom practices with their observed classroom practices. An observational study design was adopted for this study. The data collecting instruments were the Teachers' Classroom Practice Observation Checklist (TCPOC), the Teachers' Classroom Practices Check-List (TCPC) and direct observations. The study revealed that the science teachers utilized several transmissionist and constructivist inclined practices in classroom instruction and that there were significant differences in science teachers' report of their classroom practices and their observed practices. Based on the study findings, it was recommended that science teachers should be encouraged to attend workshops and seminars that will ultimately improve their use of student-centred teaching practices which are in line with current research findings and curriculum policies.

Keywords:- *Pedagogical practices, Science, Teaching, Secondary schools*

I. INTRODUCTION

For the objectives of science instruction to be attained, researchers and authorities in science education have advocated for a wide variety of research-based, innovative, learner-centered teaching strategies and methods, such as inquiry-based methods (Omoifo, 2012), cooperative learning strategies (Ugbaja and Egbunonu, 2012); Use of Problem solving teaching strategy (Bichi, 2012), and variants of the conceptual change models among others. However, classroom observations in Nigerian secondary schools indicate that science classroom activities have remained highly expository and teacher-centered (Owolabi 2012, and Njoku 2004). Ifeakor (2006) and Ossai (2004) observed that despite the availability and recommendation of innovative teaching methods, science teachers still exhibit absolute dependence on the expository methods in which they simply deliver pre-planned instruction to learners with or without the use of learning materials.

These teaching methods encourage learners to memorize course content by rote, and to complete or "cover" the curriculum before the terminal certificate awarding examination was due. The conventional teaching methods adopted by science teachers are obviously not yielding results as students have continued to perform poorly in the sciences (WAEC 2008, 2010, 2014; Omoifo 2012). Science teachers' continued reliance on teacher-centered methods and strategies has been explained by teachers' lack of competence in teaching most science subjects (Ezekannagha 2008; Okebukola 2005; Esiobu 2000); teachers' lack of awareness of the existence of novel teaching strategies (Ossai, 2004); lack of adequate physical infrastructure, laboratories, laboratory equipment, and science textbooks; as well as science curriculum that did not direct inquiry (Omoifo, 2012); and inadequate professional development accentuated by complete lack of training of science teachers in areas such as improvisation, management of large classes and teaching of difficult concepts (Owolabi, 2012).

It is pertinent to note that most research works on teachers' classroom practices are surveys and have often categorized teachers' classroom activities according to conventional teaching strategies/methods (e.g. Njoku and Okoli, 2013). Categorizing teaching into simple dichotomous groups (such as lecturing vs. interactivity), provides an inaccurate and coarsely grained perspective of teaching that does not reflect the realities of classroom practice (Hora and Ferrare, 2014) as "teaching itself is a complex and dynamic activity and many things may occur simultaneously during a lesson" (Richards and Farrell, 2011). Thus, most teachers may combine several pedagogical strategies in the course of a lesson. This is buttressed by Ravitz, Becker and

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Wong's (2000) assertion that most teachers are eclectic, choosing from a large repertoire of teaching strategies as the particular situation warrants.

Nevertheless, according to Ravitz, Becker and Wong, behind teachers' specific teaching practices and beliefs about teaching are two over-arching approaches to teaching that represent different and somewhat incompatible models of good pedagogy:

(i) Traditional transmission (behaviorist) instruction – based on a theory of learning that suggests that students will learn facts, concepts and understandings by absorbing the content of their teachers' explanations or by reading explanations from text and answering related questions. For transmissionists, the teacher's job consists of planning a set of activities in which particular subject content is experienced by students, and clearly defining in details, procedures for students' independent work so that their work is accomplished efficiently with few errors and minimal confusion.

(ii) Constructivist-compatible instruction – based on a theory of learning that suggests that understanding arises only through prolonged engagement of the learner in relating new ideas and explanations to the learner's own prior beliefs. For constructivists, the teacher's role is to facilitate student-designed efforts, thus making learning a personal, active and self-directed effort, by creating learning environments that permit students to assume the responsibility for their own learning.

Research works on science teachers' classroom practices have not been able to capture science teachers' own report of their classroom practices. Classroom practices refer to all that the teacher does regularly in the classroom during classroom interactions with students to bring about learning in students (Kalu-Uche, 2010). Furthermore, Cotton 1995 in Khader (2012) defines classroom practices as "a set of teaching strategies and methods of instruction employed in the classroom; The interaction between the teacher and his students in order to expand their cognitive and skillful perceptions through the appropriate classroom management, determination to teach and continuous evaluation to achieve the desired teaching objectives." The foregoing definitions imply that teachers employ several pedagogical practices in the course of any given lesson.

The arguments about teachers' classroom practices make it imperative to ascertain what classroom practices science teachers employ in their regular interactions with students. Therefore, this study sought to find out the extent to which science teachers' pedagogical practices are constructivist or transmissionist (behaviorist) oriented, and the extent to which science teachers' report of their pedagogical practices relate to their actual (observed) classroom practices.

Specifically, the study sought to:

Find out the extent to which science teachers' pedagogical practices are constructivist or transmissionist (behaviorist) oriented and to determine the extent of relationship between science teachers' self-report of their pedagogical practices and their actual (observed) classroom practices.

Research Questions

1. To what extents is science teachers' pedagogical practices constructivist or transmissionist oriented?
2. How does science teachers' report of their pedagogical practices relate to their actual (observed) classroom practice?

Research Hypothesis

There is no significant difference between science teachers' self-report of their classroom practices and their actual (observed) classroom practices.

II. Method

An observational study design was adopted for this study. This design was adopted so that the researchers could accurately record aspects of science teachers' classroom practices. The population for the study consisted of all the 589 science teachers (biology, chemistry, and physics only) employed in government-owned secondary schools in Rivers State, Nigeria (2010/2011 session). The sample consisted of 31 science teachers randomly selected from four senior secondary schools in two randomly selected Local Government Areas in Rivers State.

Direct observations and checklists were employed as the major instruments for data collection. (a) The Teachers' Classroom Practice Observation Checklist (TCPOC) consisted of 14 observable characteristics which required the researchers to record the presence or absence of each of the characteristics in the course of the lesson. The quality of or degree to which a characteristic was present was not recorded. The items on the checklist were defined in precise operational terms to guide observation; this ensured that the observers' own feelings, attitudes, values and past experiences did not distort the observations. Classroom observations were carried out during normal classroom instruction. This ensured that the observed teachers' activities were not stage managed. Observation times were not restricted to either morning or afternoon periods. The researchers

observed and ticked off the checklist during classroom instruction. This enabled the researchers to observe and record only clearly specified and appropriate traits and characteristics. Each of the teachers was observed thrice. (b) The Teachers' Classroom Practices Check-List (TCPC) consisted of 14 items requiring the teachers to state whether or not they used certain strategies in their classrooms. The observers' checklist (TCPOC) and the teachers' checklist (TCPC) were adapted from the Teaching, Learning and Computing: 1998 survey instrument developed by Ravitz, Becker and Wong (2000) which was used in the United States of America for a nation-wide survey investigating the relationship between teacher pedagogy and their use of computers in teaching. The Teachers' Classroom Practices Check-List (TCPC) was administered to each of the observed science teachers two weeks after he/she had been observed. The data collected by the instruments were used to answer the research questions and to test the hypothesis. The research questions were answered using descriptive statistics.

Research Question 1
To what extent is science teachers' pedagogical practices constructivist or transmissionist oriented?

Table 1: Frequencies and Percentages of science teachers' actual (observed) classroom practices

	Teachers' classroom practices	freq	%
a	Teachers encourage students to suggest or help to plan classroom/laboratory activities.	3	9.67
b	Teachers ask questions to see if students know the correct answer.	31	100
c	Teachers allow students to work in small groups to come up with a joint solution or approach to a problem or task.	7	22.5
d	Teachers allow students to work individually answering questions in textbooks or workbooks	25	80.6
e	Teachers allow students to work on tasks for which they can obtain more than one correct answer	15	48.1
f	Teachers allow students to work on projects that take a week or more to complete	3	9.67
g	Teachers allow students to debate and argue a point of view that are not necessarily their own	14	45.2
h	Teachers allow students to represent the same idea or relationship in more than one way	5	16.1
i	Teachers teach scientific facts by explaining answers to 'past' questions directly to students	29	93.5
j	Teachers allow students to do hands-on laboratory activities with clearly defined directives	22	70.9
k	Teachers allow students to justify and explain their reasoning concerning specific topics or ideas when participating in classroom activities	17	54.8
l	Teachers allow students to decide on their own procedure for solving a problem	11	35.4
m	Teachers allow students to work on tasks with no indisputably correct answer	11	35.4
n	**Teachers lead whole-class discussions in which students only listen and answer questions**	**25**	**80.6**

Considering observations of science teachers' classroom practices on the constructivist – behaviorist dichotomy, the science teachers utilized more behaviorist-inclined practices than constructivist-inclined practices in science instruction. All the teachers observed asked questions to see if students knew the correct answers (100%); most of the teachers (93.5%) taught scientific facts by explaining answers to past questions to students; 80.7% of the observed teachers led whole-class discussions in which students only listened and answered questions and 80.6% of the teachers allowed students to work individually to answer questions in textbooks/workbooks. However, only 9.67% of the science teachers encouraged students to help plan classroom/laboratory activities and to work on projects that take a week or more to complete. 16.1% of the teachers allowed students to present the same idea in diverse ways.

Research Question 2
How does science teachers' report of their pedagogical practices relate to their actual (observed) classroom practice?

Table 2: Frequencies and percentages of teachers' self report and observed classroom practices

		Teachers' Self Report of classroom practice		**Observed (Actual) classroom practice**	
	Teachers' classroom practices	freq	%	freq	%
a	Teachers encourage students to suggest or help to plan classroom/laboratory activities.	23	74.1	3	9.67
b	Teachers ask questions to see if students know the correct answer.	31	100	31	100
c	Teachers allow students to work in small groups to come up with a joint solution or approach to a problem or task.	28	90.3	7	22.5
d	Teachers allow students to work individually answering questions in textbooks or workbooks	29	93.5	25	80.6
e	Teachers allow students to work on tasks for which they can obtain more than one correct answer	10	32.2	15	48.3
f	Teachers allow students to work on projects that take a week or more to complete	10	32.2	3	9.67
g	Teachers allow students to debate and argue a point of view that are not necessarily their own	15	48.3	14	45.2
h	Teachers allow students to represent the same idea or relationship in more than one way	13	41.9	5	16.1
i	Teachers teach scientific facts by explaining answers to 'past' questions directly to students	23	74.1	29	93.5
j	Teachers allow students to do hands-on laboratory activities with clearly defined directives	31	100	22	70.9
k	Teachers allow students to justify and explain their reasoning concerning specific topics or ideas when participating in classroom activities	24	77.4	17	54.8
l	Teachers allow students to decide on their own procedure for solving a problem	24	77.4	11	35.5
m	Teachers allow students to work on tasks with no indisputably correct answer	14	45.2	11	37.0
n	**Teachers lead whole-class discussions in which students only listen and answer questions**	**25**	**80.6**	**25**	**80.6**

On several points, teachers' report of their classroom practices closely aligned with their actual (observed) practices. For example, 100% of the teachers report that they ask questions to see if students know the correct answer; also, 80.6% of the teachers lead whole-class discussions in which students only listen and answer questions. In most case items examined, there were discrepancies between science teachers' report of their classroom practices and their actual (observed) practice. For instance, 74.1% of teachers report they allow students to help plan classroom/laboratory activities, nevertheless, only 9.67% of the teachers were observed doing so. Furthermore, 90.3% of the teachers report they allow students to work in small groups to come up with a joint solution to problems, but only 22.5% of the teachers were seen to actually apply it while teaching. 77.4% report they allow students to decide on their own procedure for solving problems while observations indicate that only 35.5% actually allowed the students to decide on their own procedure for solving problems. Also, 100% of the teachers report they give clearly defined instructions before they allowed students to carry on laboratory activities, whereas only 35.5% gave such clearly defined instructions to students.

Research Hypothesis

There is no significant difference between science teachers' self-report of their classroom practices and their actual (observed) classroom practices.

Table 3: A 2x2 contingency table cross classifying 31 teachers' self report of their pedagogical practices and researchers' report of actual/observed classroom practices

	Observed	**Not observed**	**Total**
Teachers' report	300 (259)	134 (175)	434
Actual practice	218 (259)	216 (175)	434
Total	518	350	868

*Numbers in parentheses represent expected frequencies

Calculated $X^2 = 32.19$
Critical region (at df= 1) = 3.841

Decision = since the calculated X^2 of 32.19 is greater than the tabulated X^2 of 3.841, the null hypothesis that there is no significant difference between science teachers' report of their classroom practices and their actual (observed) classroom practice is rejected and the alternative hypothesis that there was a significant difference between science teachers' self-report of their classroom practices and their actual/observed classroom practice is accepted.

III. DISCUSSION OF FINDINGS

Classroom observations indicated that science teachers utilized several transmissionist and constructivist inclined practices in classroom instruction. This finding agrees with Richards and Farrells' (2011) assertions that several activities occur simultaneously during a lesson. It also agree with Ravitz, Becker and Wong's (2000) assertion that most teachers are eclectic, and often combine several pedagogical practices in the course of any given lesson. However, the science teachers utilized more transmissionist attuned classroom practices. This is consistent with research reports that science classroom activities in Nigeria are highly expository and teacher-centered (Owolabi 2012, Ajibola 2008, and Njoku 2004). This result also agrees with Kalu-Uche, Alamina and Adolphus' (2009) report that science teachers are not using constructivist-based strategies to any appreciable extent in classroom instruction.

Statistically, science teachers' report of their classroom practices did not closely align with their observed practices. The differences in science teachers' report of their classroom practices and their observed practices suggests that science teachers do not accurately report on their classroom practice.

IV. CONCLUSION

Based on the analysis of data, it is pertinent to conclude that activities in science classrooms in Rivers state are dominated by transmissionist-oriented pedagogical practices which are essentially teacher-centered. These pedagogical practices, as shown by research, have not yielded positive results in science teaching and learning. Therefore, science teachers should be encouraged to attend workshops and seminars that will ultimately improve their use of student-centered teaching practices which are in line with current research findings and curriculum policies.

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