Private and Public Secondary School Chemistry Teachers' Instructional and Evaluative Competencies

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The purpose of this study was to examine the classroom instructional and evaluative competencies (CIEC) of private and public high school chemistry teachers. The investigation used a descriptive survey research design. Seven hundred and fifty chemistry teachers were randomly selected from six states in South Western Nigeria. A questionnaire was developed and validated yielding reliability coefficient of 0.81 using KR-20. Data were analysed using t-test statistics. Significant differences were established between private and public school chemistry teachers' instructional competence based on their lesson note preparation, use of chemistry textbooks, relevant qualifications, practical demonstrations and drawing chemistry diagrams instructional competencies. It was also observed that the two groups differ in evaluative competence in relation to chemistry item generation, marking guide preparation, giving of assignment, teachers' response to students' questions and continuous assessment record keeping. Generally, private high school teachers exhibited greater competencies in both instructional delivery and evaluation of their students. It is essential for public school chemistry teachers to be orientated for improvement in both their instructional and evaluative competence through in-service trainings, workshops and supervision and monitoring.

Keywords: Instructional Competence, Evaluative competence, Science education

Introduction

The Nigerian educational system is dynamic from every facet of life. In terms of ownership, most states allowed private participation in education development by giving licences to operate private schools. Government placed the supervision of such schools under various ministries of education at both federal and state levels. Such monitoring procedures are meant to inculcate quality in the school system whether private or government (public). The core activities in the school system are instructional delivery to students and evaluation of same to ascertain the attainment of the goals of the schools. Classroom is the engine room of education where all organs of the system work together for effective implementation of the curriculum. What goes on in the classroom is the pivot of attraction to all agencies for through it the efficiency of teachers is measured. Teachers then directly pilot everything that happens within the classroom.

Chemistry occupies a central position to man's survival. It is that aspect of science that deals with the nature of matter, its properties and changes. Ezeliora (2009) posited that the power of chemistry is what creates as a whole of enabling infrastructure that delivers food, medicine and materials which are the hall mark of modern life.

Chemistry is concerned with structure and changes which accompany them (Ibole, 2009). He further described chemistry as the bride of the sciences for the important role it plays in understanding the nature and properties of the universe. Chemistry is an experimental subject which can be effectively taught and learnt by exposing learners in experimentation. A professionally qualified chemistry teacher no matter how well trained, would be unable to put his ideas into practice if the school setting lack the equipment and materials necessary to translate his/her competence to reality (Ezeliora, 1999). Success of chemistry instructional competence depends on practical activities in teaching and learning which has motivational effects on students (Kempa, 1990).

The performance of secondary school students in science-based subjects (including Chemistry) in Nigeria has not been encouraging in spite of the government efforts to boast the trends. The results of chemistry students in WAEC and NECO in the recent times showed low and fluctuating performance as revealed in Tables 1 and 2.

Table 1: Chemistry Results for the May/ June WAEC SSCE (2004-2009)

Year	Entry	Sat	Credit (A1-C6) (%)	Pass (D7-E8) (%)	Failed (%)
2004	345078	340774	128133 (37.60)	95404 (28.00)	117237 (34.40)
2005	338307	327225	135544 (41.42)	84267 (25.75)	107414 (32.83)
2006	389315	375285	140263 (37.38)	89998 (23.98)	123204 (38.64)
2007	432230	422681	194284 (45.96)	104680 (24.76)	111322 (26.33)
2008	428513	418423	185949 (44.44)	114697 (27.41)	110417 (26.38)
2009	478235	468546	204725 (43.69)	114020 (24.33)	119260 (25.45)

Source: West African Examination Council Test Development Division, Nigeria.

Table 2: Chemistry Results for the May/ June NECO SSCE (2004-2009)

Year	Entry	Sat	Credit (A1-C6) (%)	Pass (D7-E8) (%)	Failed (%)
2004	286900	277393	163724 (52.02)	95404 (28.00)	117237 (34.40)
2005	281648	270628	134405 (49.66)	84267 (25.75)	107414 (32.83)
2006	304890	291344	135253 (46.42)	89998 (23.98)	123204 (38.64)
2007	340281	333303	176691 (53.01)	104680 (24.76)	111322 (26.33)
2008	388996	344766	258835 (75.08)	114697 (27.41)	110417 (26.38)
2009	415497	402785	169216 (42.01)	114020 (24.33)	119260 (25.45)

Source: National Examinations Council Test Development Division, Nigeria.

From Tables 1 and 2 students' performance in SSCE Chemistry over the six years reviewed has been low from the WAEC results where the percentages of those that D7 to E8 and Failure grades were higher than those who obtained A1 to C6 grades. From the NECO result, students' performance seemed to be better than WAEC but fluctuating in which the best NECO result was obtained in 2008. The inconsistence in

performance trends might be due to learning styles of the students or academic learning time that is available for the students.

Jong, Acampo and Verdock (2006) concluded that teachers' scientific expertise is an important source of difficulties when teaching oxidation-reduction reactions. They suggested that there must be an improvement of current chemistry classroom practice and content-related teaching through trainings. Research has also revealed that many difficulties in learning chemistry are caused by viewing chemistry instruction that is oriented primarily as academic and not related to the chemistry of everyday life (Treagust, Duit & Fraser, 1996). Umoren (1998) suggested that it is necessary to provide students with an accurate picture of requirements and opportunities involved in the multitude of careers available in chemistry education. Chemistry is a link to all other scientifically based fields such as medicine, pharmacy, engineering, agriculture, and metallurgy, geology pure and biological sciences. Chemistry lessons should therefore evolve creative ways of integrating process, practicals and skills into instructional delivery involving models of learning as a challenge to help teachers think about teaching and learning for reliance.

Roberts and Dyer (2004) posited that teachers' effectively plan for instruction, evaluate students, recognise achievement, determine students' needs, use variety of teaching strategies and have excellent knowledge of subject matter which make them relevant in the classroom. Teachers' responsibilities are categorised into five sections which include planning of instruction, execution of instruction, evaluation of instruction, guidance and management as reported by Shippy (1981). Execution of instruction involves giving assignment in clear and concise manner; reinforce learning and direct students in applying problem-solving techniques. Current studies such as Roberts, Dooley, Harlin and Murphey (2006) posited that instructional knowledge of teachers should include content specialisation and broad knowledge of the subject, instructional skills in form of teaching/facilitation skills and instructional attributes of recognising individual differences, multi-tasking, mentoring and conflict resolution skills. In addition to this, Rice (2003) categorised attributes of teachers into five as experience, preparation programmes and degrees, type of certification, course taken in preparation for the profession and teachers' own tested scores. Wayne and Young (2003) also investigated the characteristics and qualities of effective teachers and concluded that students learn more from teachers with certain characteristics which are reflections of their competences. Berry (2002) corroborated this by

emphasising that teacher qualities are indeed important and teachers should have focus on content knowledge.

Research studies in recent past decades supported the key behaviours that contribute to effective classroom instructions. Brophy (2002), Marzano, Pickering and Pullock (2004) and Willis (2006) identified five key behaviours and five helping behaviours of a good teacher. The five key behaviours include lesson clarity, instructional variety, teacher task orientation, engagement in the learning process and student success rate. These behaviours (competencies) are essential for effective instructional delivery in chemistry classrooms. Instructional variety refers to teachers' variability or flexibility during the presentation of a lesson. Lessons should be planned to lessen the amount of disruptive behaviours but have more varied activities and materials (Emmer & Everton, 2009). Borich (2011) buttressed this point when emphasising that a teacher plans instruction based upon knowledge of subject matter, students, the community and curriculum goals. Teacher is also a reflective practitioner who evaluates the effects of his or her instructions on students and provides learning opportunities that support learners' intellectual, social and personal development.

Teachers instructional task orientation involves diagnosing how much time to spend in planning to get students to learn and the time to present lesson, ask questions, encourage students to think independently and the time to assess learners' performance. Effective teacher that is instructionally competent provides a warm and encouraging classroom climate by letting learners know that help is available from him. Therefore, a good teacher needs to show excitement, enthusiasm, voice reflection and facial experience to be to coordinate the learners in the classroom (Cabello & Terrel, 1994; Tiscler, 2005). Effective instructional practice inculcates the orchestration and integration of behaviours into meaning patterns to create effective teaching through questioning. Effective questions are those for which students actively compose responses and thereby engaged in learning processes (Chuska, 2003; Irvine, 2001). Such questions depend on more than words but word choice, voice reflection, word emphasis and the context in which they are asked. Questions are asked in the classroom to get interest, attention, diagnose, check, recall, manage and structure learning.

Weinert (2001) referred to competence to depict a roughly specialised system of abilities, proficiencies, or skills that are necessary or sufficient to reach a specific goal. He described competencies in seven ways: general competences as cognitive ability; specialised cognitive competence in a particular skill area; competence performance model;

modifications of competence performance model which relates competence to performance; cognitive competence and motivational action tendencies; objectivity and subjective competence concepts differentiating between performance and performance dispositions and action competence including all those cognitive, motivational and social prerequisites necessary for successful action and learning. For science teachers generally competence levels can be measured using cognitive, motivational and social instructional competencies in the classrooms and laboratories.

To Eraut (1994), competence is seen in a normative concepts rather than a descriptive form. He viewed competence from the behaviouristic perspective focussing more on qualifications (competence-based training), generic perspective which is based on impact, self-confidence or perceptual objectivity from managers and cognitive competence tradition. Straka (2004) summarised these two assertions to conclude that the term 'competence' has the function of an umbrella for divergent research strands in human capacity development and its assessment. It is essential to recognise that the influence of teacher' instruction and evaluation of students goes a long way to determine learning outcomes. What teachers are influence what teachers do which also affects what and how much students learn (UNESCO, 2004). Effective teachers must possess knowledge and skills required to obtain educational goals, and must be able to use that knowledge and skills appropriately if these goals are to be achieved. The possession of knowledge and skills falls under teachers' competence in the classroom. According to Babalola (2011), a professional teacher is expected to display 5CS, conscientiousness, critical thinking, competence, community spirit and commitment to professional standards and best practice. These are also essential for chemistry teachers in order to create involving classroom where each learner is given equal opportunity to learner chemical concepts.

Evaluation is central to the process of learning. How it occurs is a very powerful factor in the effectiveness of the whole process of classroom instruction. Formative evaluation assists students become aware of what they are supposed to be acquiring in the classroom and how well they are acquiring. Summative evaluation takes place to ascertain cumulative attainment of knowledge and skills a learner has acquired at the end of a course of study. Teachers need to work with students in a way that self evaluation becomes part of students' own learning process. Effective evaluation implies effective assessment (performance assessment) which allows students to ask questions to performance real-world tasks that demonstrates meaningful application

of essential scientific knowledge and skills. Beatty and Grace (2009) suggested technology-enhanced formative assessment (TEFA) as a research based pedagogy for response system in classroom instruction and based on four principles: question-driven instruction to motivate students, dialogical discourse to develop students' understanding and scientific fluency, formative assessment which informs and adjusts learning and teaching and meta-level communication that helps students develop meta-cognitive skills and cooperate in the learning process. Putting these principles in mind, evaluative competence of chemistry teachers must involve setting of chemistry questions, giving of assignments and class exercises, response to students' questions and continuous assessment record keeping.

Teachers' evaluative competence involves harnessing the events of classroom instruction to cause measurable changes in learners. Assessing the lesson outcomes therefore ascertains learners' performance using tests, homework and extended assignments and projects. Teachers' demonstration of these skills provides opportunities for learners to exhibit cognitive changes which have taken place within the walls of classroom. When teachers provide feedback to learners' questions, it informs learner the accuracy of his/her attainment in elicited response. Hearne (1992) suggested some steps schools could take to evaluate students. Such involve teachers to decide what skills cluster to evaluate and how to use existing scoring guides to measure the tasks. In students involved classroom evaluation, Stiggins (2001) discussed types of assessment methods that are matched with the assessment targets. He further suggested that selected response, essay, performance assessment and personal communication. When chemistry teachers utilise these evaluative strategies, students are moved from fact-recall-knowledge mastery to observation or skills acquire through making students to perform chemistry tasks.

The Problem

The step for allowing private proprietorship in Nigerian education system had gone a long way to alleviate the problems faced in giving admissions to secondary age school children. More children now have opportunities to go to either government (public) or private (sole-proprietorship or missionaries) schools where they could obtain overall development as good and productive citizens in the future. The dichotomy of private and public high schools brought a lot of discrepancies in the approaches of teaching employed by teachers in general and chemistry teachers in particular even though the same

curricula are being implemented by both. Due to the differences in direct supervisions of public and private schools teachers by the government, the instructional and evaluation competencies of these teachers are likely to be at par. Chemistry results over the years showed an unstable picture as it fluctuated between average and mostly below average total students' performance. One then wonders why the result was not improved upon in spite of government effort to develop science by supplying materials, employing teachers to her schools and also mandating the private schools owners to equip their laboratories and employ competent teachers to teach science subjects. In view of these, the study focused on comparing classroom instructional and evaluative competencies of private and public high schools' chemistry teachers.

Null Hypotheses

The following null hypotheses were tested at 0.05 significance level:

1) There is no significant difference in instructional competence (IC) between private and public school chemistry teachers in relation to (i) content mastery (ii) preparation of lesson notes (iii) use of chemistry textbooks (iv) relevance of qualification (v) Practical demonstration (vi) use of chemistry materials /apparatuses (vii) Chemistry diagrams drawing.
2) There is no significant difference in evaluative competence (EC) between private and public school chemistry teachers in relation to (i) Chemistry item generation (ii) chemistry marking guide preparation (iii) chemistry assignments (iv) chemistry class exercises (v) answering students' questions (vi) continuous assessment record keeping.

Methodology

The study employed a survey design in which data were gathered using questionnaires. The population for the study comprise all chemistry teachers from six (6) states from South West geo-political zone, Nigeria. Each of the states has three (3) senatorial districts. Forty (40) chemistry teachers were randomly selected from each of the senatorial districts in Oyo, Ogun, Osun, Ekiti and Ondo states to make 600. Fifty (50) teachers were randomly selected from each of the three Lagos state senatorial districts in view of high chemistry teachers' population to make 150. A total of seven hundred and fifty (750) chemistry teachers from private and public secondary schools of states were used as sample for the study.

A validated 20-item Chemistry Teachers' Instructional and Evaluative Competencies Questionnaire (CTIEQ) was developed by the researcher to collect data. The instrument had two sections A and B. Section A requested the teachers to give their personal background. Section B contained the chemistry teachers' instructional and evaluative competencies items requesting the teachers to respond 'Yes' or 'No'. The instrument was subjected to validation by three (3) chemistry and evaluation experts who scrutinised the original 30 items for modification and improvement and this reduced the items to twenty (20). The reliability of the instrument was calculated from the outcome of pilot testing by using KR-20 for dichotomous response items. The coefficient of the reliability of the questionnaire was found to be 0.81. The sampled chemistry teachers were asked to tick only one response for each item of the questionnaire. In order to test the hypotheses, the responses were subjected to t-test statistics to ascertain the significant differences at 0.05 level of significance.

Results and Discussion

The findings on the Chemistry teachers' instructional and evaluative competence are summarised in tables 3 and 4.

Table 3: Chemistry Teachers' Instructional Competence

Instructional Competence	School Type	N	Mean	Std Dev.	Std. Error	t	Df	P
I display mastery of subject matter	Private	334	0.60	.490	.027	0.968	748	.333
	Public	416	0.57	.496	.024			
I prepare lesson notes before teaching	Private	334	0.74	.438	.024	1.725	748	.045*
	Public	416	0.69	.465	.023			
I depend more on Chemistry textbooks when teaching	Private	334	0.53	.500	.027	0.831	748	.406
	Public	416	0.50	.501	.025			
My qualification is not relevant to teaching Chemistry	Private	334	0.40	.490	.027	1.468	748	.014*
	Public	416	0.35	.476	.023			
I engage students in practical activities	Private	334	0.51	.501	.027	2.418	748	.016*
	Public	416	0.42	.494	.024			
I can manipulate apparatus to demonstrate concepts	Private	334	0.65	.478	.026	2.241	748	.026*
	Public	416	0.57	.496	.024			
I illustrate with relevant diagrams	Private	334	0.60	.490	.027	2.332	748	.020*
	Public	416	0.52	.500	.025			

* = *Significant at .05 level*

Table 3 showed teachers instructional competence on related classroom activities between private and public schools' teachers. It was deduced from the table that there was no significant difference (t(748)=0.968, P>0.05) in private and public high school chemistry teachers in the

mastery of chemistry subject matters though the private school chemistry teachers displayed slight higher content mastery competence than their public counterparts. On the ability to prepare lesson notes before delivery chemistry lessons, private high school chemistry showed more appreciable competence than the public school teachers and the difference in their competencies for lesson note preparation was significant ($t(748)=1.725$, $P<0.05$). Private school teachers depended more on the use of text books to teach chemistry than the public school teachers implying that the public school teachers had greater competence to teach chemistry without the use of text books though there is no significant different ($t(748)=0.831$, $P>0.05$) in their competences for this ability.

Public school chemistry teachers had relevant qualifications because more of the private school teachers consented that their qualifications were not relevant to teach chemistry and there was a significant difference ($t(748)=1.468$, $P<0.05$) in qualifications to teach chemistry between the two groups. Private school teachers' engagements in practical activities with the students were higher than their public school counterparts and there was a significant difference ($t(748)=2.214$, $P<0.05$) in practical demonstration competence between the two groups. Private teachers had greater chemistry apparatus/materials manipulation competence than the public school teachers with a significant difference ($t(748)=2.232$, $P<0.05$) in their competencies in this regard. Also, public school teachers had lower competence in drawing chemistry related diagrams during lessons and practical classes than private counterparts who found it easy to draw diagrams to draw and the difference in their chemistry diagram drawing competencies was significant ($t(748)=2.332$, $P<0.05$).

Both public and private chemistry teachers had no significant difference in mastery of high school chemistry content. This finding corroborated the report of Shippy (1981) that when teachers undergo the same educational process to gain teaching skills, the mastery level of their subject should not exhibits serious discrepancies. The significant differences shown by public and private schools teachers in lesson note preparation, use of textbooks, relevant qualification, practical demonstration, apparatus / material manipulations and competence in diagram drawing emanated due to the effective supervision of private school chemistry teachers by their proprietors who also aims at engendering academic excellence to give name to the schools among foremost reputable ones. Due to lack of materials and students' over population in most of the public schools, chemistry teachers found it difficult to demonstrate their competencies to the fullest contrary to

what obtain among private schools where parents buy textbooks to their children and materials are available for chemistry practical.

Table 4: Chemistry Teachers' Evaluative Competence

Evaluative Competence	School Type	N	Mean	Std Dev.	Std. Error	t	Df	P
I find generation of question items difficult	Private	334	0.37	.484	.026	3.770	748	.000*
	Public	416	0.25	.431	.021			
I find preparation of Chemistry marking guide is very difficult	Private	334	0.29	.453	.025	-3.204	748	.001*
	Public	416	0.40	.490	.024			
I am often confused of appropriate class exercises to administer	Private	334	0.49	.501	.027	-0.914	748	.361
	Public	416	0.52	.500	.025			
I regularly administer Chemistry assignments	Private	334	0.59	.492	.027	1.492	748	.036*
	Public	416	0.46	.499	.024			
I find it easy to respond to students' questions	Private	334	0.74	.441	.024	1.329	748	.014*
	Public	416	0.69	.462	.023			
I keep continuous assessment records	Private	334	0.77	.424	.023	5.013	748	.044*
	Public	416	0.60	.491	.024			

* = *Significant at .05 level*

From Table 2, public school chemistry teachers found setting of Chemistry questions (item generation) easier than the private school teachers. This implied that public school teachers were more competent in setting chemistry questions than private school teachers and the difference in their competence in this area was significant ($t(748)=3.770$, $P<0.05$). In preparation of chemistry marking guide, private school teachers proved to be more competent than public schools chemistry teachers and the difference was also significant ($t(748)=-3.204$, $P<0.05$). In administration of chemistry class exercises, public school teachers were more confused of nature of chemistry class exercises to give to students though the difference in their administration of class exercise competence was not significant ($t(748)=-0.9814$, $P>0.05$. Private school teachers found giving of regular chemistry assignments to students more convenient than the public school teachers and there was a significant difference ($t(748)=1.492$, $P<0.05$) in the rate at which the two groups give assignment to students. Teachers giving of feedback by responding to students questions was more appreciable among the private school teachers than their public counterparts and the difference in exercising this competence was significant ($t(748)=1.329$, $P<0.05$). Public teachers had lower competence in keeping continuous assessment records than the private school teachers who exercise efficiency in keeping such records and there exited a significant difference ($t(748)=5.013$, $P<0.05$) in continuous assessment record keeping competence between the two groups

Private school teachers also showed more competence in evaluating their students than their public school counterparts. Due to overpopulated class size in the public schools, teachers in these schools tend to rationalise the number of tests, assignments and class exercises to give the students. They found the scoring of students' performance in these assessment modes difficult to do. Unlike the private schools where teachers have less students to deal with and can give as many tests, exercises and assignments as much as possible. Also, since the private schools are under the administration of most proprietors, close monitoring and regular checks of teachers' continuous assessment records of students are routinely done, such teachers often seat tight to make their records intact and update. The public school teachers feel that they and their administrators are civil servants employed by the government and so administrators have no absolute power to discipline or sack them. So they could evaluate their students using any convenient means for them.

Conclusion and Recommendations

It is evident from the findings of this study that there exist variations in the instructional and evaluative competencies of private and public chemistry teachers. The differences were exhibited in lesson note preparation, use of chemistry text books, relevant qualifications, practical demonstration, material and apparatus manipulation and chemistry related diagrams competencies but no difference was noticed in their mastery of chemistry concepts. Private school chemistry teachers are more competent in most of these areas except that public school chemistry teachers are more qualified than those in private schools. On evaluative competence, variations exist in chemistry item generation, chemistry marking guide preparation, giving of assignments, response to students' questions and keeping of continuous assessment records. No significant difference was noticed in their class exercise administration competence. Private school chemistry teachers showed greater evaluative competence than the public teachers.

In view of the findings, there is a need for education authorities to carry out close supervision and inspection of chemistry teachers in order to increase their instructional and evaluative competences. Schools need to train teachers on how to write lesson notes using more experienced ones. Public school chemistry teachers should be exposed to seminars and workshops to update their knowledge and competencies in lesson note writing, use of textbooks to support instructional delivery, practical demonstrations, apparatus / material

manipulation and chemistry diagram dexterity. Teacher training institutions should enhance their course materials to beef up the instructional and evaluative competence of the would-be teachers in order to meet up with high students population, Information Communication Technology (ICT) and modern-day emphasis on learners' centred instructions.

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