SCIENCE AND MATHEMATICS TEACHERS' COMPETENCY IN EVALUATING STUDENTS' AFFECTIVE AND PSYCHOMOTOR DOMAINS OF SENIOR SECONDARY CLASSROOM INSTRUCTION IN BENUE STATE

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Abstract

This was a study on science and Mathematics teachers' competency in evaluating students' affective and psychomotor domains of senior secondary classroom instruction in Benue State. Four research questions and four null hypotheses were formulated to guide the study. Descriptive survey design was used. Population comprised all Science and Mathematics teachers in Makurdi LGA of Benue State. Sample consisted of 104 (78 Science and 26 Mathematics) teachers in 26 senior secondary schools obtained using multi-stage sampling. Validated Science and Mathematics Teachers Competence in Evaluating Classroom Instruction Questionnaire (SMTCECIQ) constructed by the researchers had reliability coefficient of 0.89 computed using Cronbach alpha. Data obtained were analyzed using mean and standard deviation to answer the research questions and Independent sample t- test to test the formulated null hypotheses at 0.05 level of significance. Results showed: significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' affective area during classroom instruction; No significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' psychomotor area during classroom instruction; No significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' affective and psychomotor areas during Mathematics classroom instruction. The study recommended among others that, science teachers Association and Mathematics Association of Nigeria should frequently organise conferences, seminars and workshops and encourage teachers to attend in order to increase their knowledge and skills to objectively evaluate students' affective and psychomotor areas.

Keywords: Evaluation, teachers' competences, science and Mathematics, STEM

Introduction

Important educational goals in Nigeria relate to science and mathematics. Science deals with explanation of pattern and natural phenomena about the universe. Samba, Kpiranyam, Ode and Onyilo, (2021) opined that scientific knowledge gives birth to sustainable development and improved quality of life. In Nigeria, science subjects like Biology, Chemistry and Physics are important in laying a solid foundation for scientific and technological development (Ellah & Nnadi, 2020). As expected, in the National Policy on Education (FRN, 2014), one of the objectives of education is to lay a solid foundation for scientific and reflective thinking of learners. Science is also related to Mathematics. John and Okpara (2019) stated that Mathematics is a subject that has the function of developing students' skills, knowledge, attitude and values towards solving problems and satisfaction of real life needs. Due

to the great importance attached to the learning of science and Mathematics especially in STEM programme. This is because STEM education students receive could stimulate collaboration, teamwork, creativity, critical thinking and problem solving (Shernoff, Sinha, Bressler & Ginsburg, 2017). However, Adenle (2015) noted that Nigeria has not invested much in research including STEM. This may affect Science and Mathematics teaching and learning especially the teachers' competency to evaluate students' abilities.

Teachers' expertise and knowledge to carry out evaluation progressively in schools is questionable as students do not receive feedback from continuous assessments conducted on them. That is if it is conducted at all. This is worrisome, as there are indications that continuous assessment strategies positively influence students' academic performance (Agbidye&Orhii, 2022). Students on their part may prefer learning without been evaluated. Nitko (2015) in Akanni (2019) opined that students have mixed feelings that they are always under surveillance for every mistake they commit, which have a negative impact on the students' performance. That is, lack of competence on the part of teacher can mar the outcome of continuous assessment (Akanni, 2019). The National Policy on Education (FRN, 2014) stressed that no education can rise above the quality of its teacher. This implies that not only teachers' qualification(s) or training that is essential to quality education but also teachers' competency is sacrosanct to the attainment of such educational goals.

The professional science and Mathematics teacher is expected to possess certain competence both professional and personal. Zamri and Hamzah (2019) opined that teachers' competence is an important factor which comes handy when teaching and assessing students. Professional competences are both academic and pedagogical. Academic competencies are the teachers' knowledge of his subject. While accordingly to Lawyer (2019) pedagogical competency is the art of teaching the subject, observing such principles as teaching from known to unknown, concrete to abstract and from simple to complex. Competence has mental component involving thought and a behavioural component involving competent professional performance. To influence the desired student performance in the sciences, teacher competence goes beyond mere possession of the requisite knowledge, skills and attitudes. A competent Science Education teacher has a good classroom control, effective communicative skills, adequate knowledge of the subject, utilize a variety of teaching methods, or strategies and show enthusiasm for teaching (Lawyer, 2019) and should be able to effectively evaluate the teaching and learning.

Evaluation is a very important part of education. Evaluation, according to Nworgu (2015), is a process of seeking, obtaining and quantifying data with a view to making value judgment about objects, events or their characteristics. Evaluation in education refers to the collection of data and the use of such data to assess the quality of students' performance and effectiveness of a programme. Evaluation in education involves three domains, namely: cognitive, affective and psychomotor. However, Achor, Ajayi, Ikwu and Onyche (2020) opined that the affective domain is not emphasised like the cognitive. This may result to inability to develop a holistic individual. Cognitive component/areas deal with intellectual outcomes of instruction, thinking, memory, knowing and problem solving rearrangement and evaluation (John & Okpara, 2019). Bettel (2014) revealed that teaching strategies that developed learning at the analysis and synthesis levels of Bloom's Taxonomy were considered more successful in improving students' learning outcomes than those at the lower levels of the Taxonomy. Achor, Ajayi, Ikwu and Onyche (2020) noted that affective component focuses on attitude, motivation, willingness

to participate in learning activities, valuing what is being learned and appreciating, adjustment and incorporating good values for a meaningful life. Thus, is concerned with the worth learners attach to a phenomenon which is reflected by active participation on the part of the learners. Bettel (2014) asserted that affective domain includes emotions, feelings, values, and acceptance or rejection of a topic, the cognitive domain represents intellectual responses, and the psychomotor domain is a measure of the development of physical motor skills. Regarding psychomotor domain, Achor, Ajayi, Ikwu and Onyche (2020) opined that it deals with development of manipulative and coordination skills in learners. The psychomotor domain according to Rahayu and Munadhiroh (2020), captures seven types of attributes which are perception, readiness, guided movements, accustomed movements, complex movements, adjustments, and creativity which can be expressed through engaging in a task, observations and actions.

Science and Mathematics teachers should evaluate all the three domains of the student's learning to enhance a better application and performance in STEM programme. Such holistic evaluation will develop and establish in students, adequate knowledge, skills and positive attitude towards Science, Mathematics and Technology. However, science and mathematics teachers' pay more attention in evaluating the cognitive aspects of learning neglecting the affective and psychomotor aspect. Inversely, Agi, Aduloju and Kpum (2018) reported that teachers have positive attitudes towards assessing affective and psychomotor domain. Could it be that these teachers lack the competency in evaluating these very important domains of learning? Studies abound in the literature (Oyewole, 2011; Naderi, Raji, &Mehrabifar, 2012; Naderi, Raji &Mehrabifar, 2012; Adodo, 2014; Ewetan&Ewetan, 2015; Chioma, 2016; Agi, Aduloju&Kpum, 2018; John & Okpara, 2019) no doubt, however, there are few studies carried out to ascertain the competences of secondary school science and Mathematics teachers' classroom instructions and these few studies did not consider both affective and psychomotor abilities of students especially in Benue State to the best of the knowledge of the researchers. Against this background this study examined science and Mathematics teachers' competency in evaluating students' affective and psychomotor domains of senior secondary classroom instruction in Benue State.

Research Questions

The study will be guided by the following research questions:

1. What is the mean rating of science and Mathematics teachers' competency to objectively evaluate science students' affective areas during classroom instruction?
2. What is the mean rating of Mathematics teachers' competency to objectively evaluate science students' psychomotor areas during classroom instruction?
3. What is the difference in the mean ratings of science teachers' competency to objectively evaluate science students' affective and psychomotor areas during science classroom instruction?
4. What is the difference in the mean ratings of Mathematics teachers' competency to objectively evaluate science students' affective and psychomotor areas during Mathematics classroom instruction?

Hypotheses

The following hypotheses are formulated and were tested at 0.05 level of significance:

H_{o1}: There is no significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' affective areas during classroom instruction. **H_{o2}:** There is no significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' psychomotor areas during classroom instruction.

H_{o3}: There is no significant difference in the mean ratings of science teachers' competency to objectively evaluate science students' affective and psychomotor areas during science classroom instruction. **H_{o4}:** There is no significant difference in the mean ratings of Mathematics teachers' competency to objectively evaluate science students' affective and psychomotor areas during Mathematics classroom instruction.

Methods

The study adopted the discriptive survey, which was used in order to collect information and to discribe the characteristics of the population which is teaching competencies and evaluation skills of Science and Mathematics teachers. The population of the study comprised all Science and Mathematics teachers in Makurdi LGA of Benue State out of which a sample of 104 (78 Science and 26 Mathematics teachers) in 26 senior secondary schools in the study area. The study employed the multi-stage sampling involving purposive, proportionate and simple random sampling methods. The Science and Mathematics Teachers Competence in Evaluating Classroom Instruction Questionnaire (SMTCECIQ) was constructed by the researchers. The instrument had two sections. Section A required the respondents to write the name of their school and subject taught. Section B had two clusters. The first cluster had 14 items which ascertained the teachers' competency to objectively evaluate students' affective ability during classroom instruction while the second cluster had 12 items which probe into the teachers' competency to objectively evaluate science students' affective ability during classroom instruction. The instrument was on a four-point Likert-like scale. The ratings was Very Competent (VC=4), Competent (C=3), Moderately Competent (MC=2) and Not Competent (NC=1) respectively. The instrument was validated by three experts in Science and Mathematics Education department at Benue State University, Makurdi.

To establish the level to which SMTCECIQ were reliable they were administered on Science and Mathematics teachers from four schools, which were part of the population but not part of sampled schools for the study. The reliability coefficient of SMTCECIQ yielded 0.89 computed using Cronbach alpha. The researchers administered the instruments in the sampled schools with the help of research assistants after obtaining permission from the respective school administrators. Mean and standard deviation were used in answering the research questions. The decision (remark) was based on the range of the mean as follows: 0.01-0.99 Lowly Competent (LC), 1.01-2.00 Moderately Competent, 2.01-3.00 Competent (C) while 3.01-4.00 indicate Very Competent (VC). Independent sample t- test was used to test the formulated hypotheses at 0.05 level of significance.

Results

Research Question One

What is the mean rating of science and Mathematics teachers' competency to objectively evaluate science students' affective areas during classroom instruction?

Table 1

Mean and Standard Deviation of Teachers' Competency to Objectively Evaluate Students' Affective Areas during Classroom Instruction *(Science n=78 and Mathematics n= 26*

S/No	Affective Measures	Science		Remark	Mathematics		Remark
	I always assess students:	$\bar{x}$	SD		$\bar{x}$	SD	
1	Ability to self-motivate	1.93	0.70	MC	1.88	0.92	MC
2	Punctuality to classes	2.89	0.60	C	3.27	0.64	HC
3	Attendance to classes	2.92	0.79	C	3.21	0.65	HC
4	Attentiveness during classes	2.49	0.81	C	3.14	0.61	HC
5	Carrying out assignments	2.64	0.93	C	2.97	0.83	C
6	Organizational ability during Lesson	3.03	0.75	HC	2.89	0.69	C
7	Willingness to participate in learning activities in class	2.49	0.60	C	2.36	0.72	C
8	Neatness in presentation of solution to problem on paper	2.32	0.59	C	3.27	0.84	HC
9	Politeness in discussing during classes	2.59	0.71	C	3.01	0.65	HC
10	Honesty in reporting assignment	2.24	0.63	C	3.14	0.69	HC
11	Peer-collaboration during learning in class	2.36	0.70	C	2.97	0.83	C
12	Obedience to instructions during classes	3.00	0.68	HC	2.89	0.99	C
13	Ability to accept responsibility during lessons	2.22	0.89	C	2.86 is	0.72	C
14	Students' attitude towards classroom activities	2.47	0.99	C	2.79	0.94	C
	Cluster Mean and Standard Deviation	**2.54**	**0.74**	**C**	**2.90**	**0.77**	**C**

Result in Table 1 shows that science teachers have a cluster mean of 2.54 with standard deviation of 0.74 while mathematics teachers have mean ratings of 2.90 with standard deviation of 0.77 respectively indicating that they are both competent in objectively evaluating science students' affective areas during classroom instruction. However, the mean difference of 0.36 is recorded between the groups in favour of mathematics teachers indicating that they are more competent.

Research Question Two

What is the mean rating of science and Mathematics teachers' competency to objectively evaluate science students' psychomotor areas during classroom instruction?

Table 2

Mean and Standard Deviation of Teachers' Competency to Objectively Evaluate Students' Affective Areas during Classroom Instruction (Science n=78 and Mathematics n= 26)

S/No	Psychomotor Measures	Science		Remark	Mathematics		Remark
	I always assess students:	$\bar{x}$	SD		$\bar{x}$	SD	
1	Ability to identify measuring instruments	2.88	0.74	C	2.91	0.58	C
2	Handling of measuring instruments	2.72	0.96	C	2.82	0.96	C
3	Ability to use measuring instruments	3.01	0.66	HC	3.33	0.63	HC
4	Completion of measuring task within the stipulated time	3.35	0.68	HC	2.44	1.07	C
5	Proper application of techniques	3.10	0.65	HC	2.37	0.98	C
6	Ability to follow the specific steps	2.83	0.74	C	3.35	0.67	HC
7	Ability to frequently use equipment to perform tasks	1.52	0.66	MC	1.61	0.58	LC
8	Ability to identify particular deficiencies, take action	3.21	0.66	HC	2.42	0.85	C
9	Ability to perform a skill while observing teacher demonstration	2.75	0.68	C	3.33	0.63	HC
10	Ability to draw/sketch during lesson	2.60	1.07	C	2.94	1.07	C
11	Ability to take a specification of a work output required	2.48	0.99	C	2.77	0.73	C
12	Ability to perform a skill with high degree of precision	1.92	0.66	MC	1.45	0.97	LC
	Cluster Mean and Standard Deviation	**2.70**	**0.76**	**C**	**2.65**	**0.81**	**C**

Data in Table 2 reveals that science teachers have a cluster mean of 2.70 with standard deviation of 0.76 while Mathematics teachers have mean ratings of 2.65 with standard deviation of 0.81 respectively indicating that they are both competent in objectively evaluating science students' psychomotor areas during classroom instruction. Nevertheless, the mean difference of 0.05 is recorded between the groups in favour of science teachers indicating that they are more competent in evaluating students' psychomotor areas during classroom instruction

Research Question Three

What is the difference in the mean ratings of science teachers' competency to objectively evaluate science students' affective and psychomotor areas during science classroom instruction?

Table 3

Mean and Standard Deviation of the science teachers' competency to objectively evaluate science students' affective and psychomotor areas

Science	n	Mean	SD	Mean Difference
Affective	78	2.54	0.74	0.16
Psychomotor	78	2.70	0.76	

Table 3 reveals that science teachers' competency to objectively evaluate science students' affective areas had a mean ratings of 2.54 with standard deviation of 0.74. On the other hand, their competency to objectively evaluate science students' psychomotor areas recorded a mean rating of 2.70 with standard deviation of 0.76. The mean difference was 0.16 indicating that science teachers' are more competent in objectively evaluating science students' psychomotor areas.

Research Question Four

What is the difference in the mean ratings of Mathematics teachers' competency to objectively evaluate science students' affective and psychomotor areas during Mathematics classroom instruction?

Table 4

Mean and Standard Deviation of theMathematics teachers' competency to objectively evaluate science students' affective and psychomotor areas

Mathematics	N	Mean	SD	Mean Difference
Affective	26	2.90	0.77	0.25
Psychomotor	26	2.65	0.81	

Data in table 4 reveals that Mathematics teachers' competency to objectively evaluate science students' affective areas had a mean rating of 2.90 with standard deviation of 0.77. Moreover, their competency to objectively evaluate science students' psychomotor areas recorded a mean rating of 2.65 with standard deviation of 0.81. The mean difference was 0.25 indicating that Mathematics teachers' are more competent in objectively evaluating science students' affective areas.

Hypothesis One

There is no significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' affective area during classroom instruction.

Table 5

t-Test of Difference in the Mean Ratings of Science and Mathematics Teachers' Competency to Objectively Evaluate Science Students' Affective Area

Group	N	Mean	SD	Df	t value	P	Remark
Science Teachers	78	2.54	0.74	102	2.127	0.036	Significant
Mathematics Teachers	78	2.90	0.77				

Data in Table 5 reveals that t = 2.127, p = 0.036 < 0.05. Hence, the null hypothesis was rejected. By implication, there is significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' affective area during classroom instruction.

Hypothesis Two

There is no significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' psychomotor area during classroom instruction.

Table 6

t-Test of Difference in the Mean Ratings of Science and Mathematics Teachers' Competency to Objectively Evaluate Science Students' Psychomotor Area

Group	N	Mean	SD	Df	t value	P	Remark
Science Teachers	78	2.70	0.76	102	0.286	0.776	Not Significant
Mathematics Teachers	26	2.65	0.81				

Data in table 6 shows that t = 0.286, p = 0.776 > 0.05. Hence, the null hypothesis was not rejected. By implication, there is no significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' psychomotor area during classroom instruction.

Hypothesis Three

There is no significant difference in the mean ratings of science teachers' competency to objectively evaluate science students' affective and psychomotor areas during science classroom instruction.

Table 7

t-Test of Difference in the Mean Ratings of Science Teachers' Competency to Objectively Evaluate Science Students' Affective and Psychomotor Areas

Science	N	Mean	SD	Df	t value	P	Remark

Affective	78	2.54	0.74				
				154	1.332	0.185	Not Significant
Psychomotor	78	2.70	0.76				

Data in table 7 shows that t = 1.332, p = 0.185 > 0.05. Hence, the null hypothesis was not rejected. This means that there is no significant difference in the mean ratings of science teachers' competency to objectively evaluate science students' affective and psychomotor areas during science classroom instruction.

Hypothesis Four

There is no significant difference in the mean ratings of Mathematics teachers' competency to objectively evaluate science students' affective and psychomotor areas during Mathematics classroom instruction.

Table 8

t-Test of Difference in the Mean Ratings of MathematicsTeachers' Competency to Objectively Evaluate Science Students' Affective and Psychomotor Areas

Domain	N	Mean	SD	Df	t value	P	Remark
Affective	26	2.90	0.77				
				50	1.141	0.259	Not Significant
Psychomotor	26	2.65	0.81				

Data in table 8 reveals that t = 1.141, p = 0.259 > 0.05. Therefore, the null hypothesis was not rejected. This implies that there is no significant difference in the mean ratings of Mathematics teachers' competency to objectively evaluate science students' affective and psychomotor areas during Mathematics classroom instruction.

Discussion

This study was on evaluation competencies of secondary school science and Mathematics teachers' classroom instruction in Makurdi LGA of Benue Nigeria. Finding revealed that there is significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' affective area during classroom instruction. This finding does not support that of Chioma (2016) which reported that Mathematics teachers were incompetent in coordinating teaching with affective assessment in class. This finding disagrees with the finding of John and Okpara (2019) that the mean rating of Mathematics teachers' competency to objectively evaluate students' affective areas of SSII Mathematics curriculum during classroom lessons is low. However, the study of John and Okpara (2019) did not compare science and Mathematics teachers. The finding also showed that there is no significant difference in the mean ratings of science and Mathematics teachers' competency to objectively evaluate science students' psychomotor area during classroom instruction. However, Naderi, Raji, and Mehrabifar's (2012) study which compared the effect of qualitative and quantitative

evaluations on realization of cognitive, affective and psychomotor objectives and found no difference between the two groups in terms of psychomotor. Furthermore, findings revealed that there is no significant difference in the mean ratings of science teachers' competency to objectively evaluate science students' affective and psychomotor areas during science classroom instruction. This is in line with Akanni (2019) found that teachers' competence and attitude towards continuous assessment does not significantly impact on the implementation of continuous assessment. This may be because as Omar, Zahar and Rashid (2019) noted adequate knowledge, skills, and attributes play major role in ensuring the competency level of teachers. Findings also showed that there is no significant difference in the mean ratings of Mathematics teachers' competency to objectively evaluate science students' affective and psychomotor areas during Mathematics classroom instruction. This may be because the teachers are committed and experienced in teaching. Oyewole (2011); Ewetan and Ewetan (2015); Adodo (2014) in their separate studies found that teachers' competency impacts their evaluation and students' learning outcomes.

Conclusion

Based on the findings of this study it is concluded that mathematics teachers are more competent than science teachers in objectively evaluating science students' affective areas during classroom instruction while the science teachers are more competent than mathematics teachers in objectively evaluating science students' psychomotor areas during classroom instruction. It was also concluded that science teachers' were more competent in objectively evaluating science students' psychomotor areas while Mathematics teachers were more competent in objectively evaluating science students' affective areas. It is also evident from the findings that both science teachers' teachers had moderate competency in objectively evaluating science students' ability to motivate them to learn which may limit their learning outcomes. In the same vein, science teachers' had moderate competency in objectively evaluating science students' ability to frequently use equipment to perform tasks and perform a skill with high degree of precision while Mathematics teachers had low competency in objectively evaluating science students' ability to frequently use equipment to perform tasks. Thus, the need to emphasize competency in objectively evaluating science students' affective and psychomotor abilities for effective teaching and learning of Science, Technology and Mathematics (STM).

Recommendations

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

1. Science and Mathematics teachers teaching science students should endeavour to immediately improve their competency to objectively evaluate students' affective areas.
2. School administrators should ensure that they provide materials and monitor teachers to objectively keep record of science students' affective areas each term just as it is objectively done for the cognitive areas.
3. Science teachers Association and Mathematics Association of Nigeria should frequently organise conferences, seminars and workshops and encourage teachers to attend in order to increase their knowledge and skills to objectively evaluate students' affective and psychomotor areas.

4. Ministries of education should supervise schools to ensure that they comply with the policy directions of government towards objective evaluation of students' affective and psychomotor areas.

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