The Attitude of some Nigerian Science, Technology, and Mathematics Teachers towards Assessment Practices

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***Abstract*— The study investigated the attitudes of 305 Science, Technology and Mathematics (STM) teachers towards assessment practices in Nigeria. The sample was selected through stratified and random sampling techniques from 171 Senior Secondary Schools in three Local Government Areas of Lagos State and data were collected using survey a instrument. The instrument required the STM teachers to indicate the extent of their agreement or otherwise, on a five–point Likert attitude measuring scale, to a set of 26 statements made on various assessment practices. Frequency counts and percentages were used to obtain a global picture of teachers' attitudes towards assessment practices, while the Chi-square (χ^2) statistic was used to find out whether any significant gender or experience or professional training group differences existed in such attitudes. Findings showed that a higher proportional of the STM teachers seemed to display positive attitudes toward most of the assessment practices, while their attitudes toward some assessment practices tended to be either negative or neutral. More so, gender, teaching experience and professional training might be factors in STM teachers' attitudes toward assessment practices.**

***Keywords*— Attitude, assessment practices, teachers, science, technology, mathematics, Nigerian.**

I. INTRODUCTION

The need for enhancing scientific, technological and mathematical literacy among students has been a major focus for science, technology and mathematics teaching at school [5, 14]. This is because a scientifically, technologically and mathematically literate citizen will not only contribute meaningfully to the improvement in science, technology and mathematics but will also be conscious of the values and dangers inherent in the use of the by-products of science, technology and mathematics [2]. Bearing in mind these potential advantages, it is strongly recommended by science, mathematics and technology (STM) educators, that the teaching of STM should be accorded appropriate attention beginning from the primary school in order to raise the level of intrinsic motivation exhibited by students and enhance scientific, technological and mathematical literacy. This recommendation has underscored the need for a system of monitoring student's progress in STM and the dire need for STM teachers to update their knowledge and skills in various assessment and evaluation procedures. Assessment in STM in school setting can serve three important functions namely instructional, guidance and administrative [4].

Testing of students' progress in the classroom provides the instructor with information on the students' rate of learning, and stimulates the review of materials previously mastered thus enabling the teacher to provide more appropriate instructional guidance and counselling service especially on matters relating to students' choice of career. Assessment also provides a mechanism not only maintaining standard for school system but also for individual standards. It functions as a type of quality control for schools STM. In general, assessment as a form of judgment can be made in two varieties of ways namely intuitive or estimated assessment and structured assessment. The former according to [6] describes the broad unspecified assessment of the students' progress and development with which the able teacher is constantly concerned and which form the hallmark of any valid teaching situation. The intuitive assessment is needed for those results of STM teaching which are unquantifiable but which should not therefore be considered impossible to assess. The structured assessment is the most accepted assessment procedure purposely designed and administered to enable the teacher to evaluate some aspects of student learning at a specific time. Structured assessments are of two types namely: Continuous Assessment and Formal Examination [4]. In Nigeria and as in other parts of the world, formal examination is dominant and continuous assessment (CASS) of students' progress was introduced into the Nigerian educational system in 1981 [3, 15, 16, 17]. The CASS is opposed to the concept of a once-for-all assessment and evaluation in the form of an "end-of-course" examination. It is a series of continuously updated measurements and judgments by the teacher of the students' attainments which may be based on weekly tests, homework, project work and various other sources applied during class instruction to obtain the overall score for a given period [4]. Continuous assessment is a device for monitoring and improving the learning and general performances of students based on systematic collection of comprehensive and diagnostic data over a specified period of time [1] and as such is said to be cumulative [3]. Its comprehensiveness, periodic, cumulative and guidance oriented features enhance the possibility for both the students and the teacher to get the requisite information that would guide the future development of the students in terms of subjects to be taken and career aspirations. The relative importance of CASS in the final grade of students in STM in Nigeria cannot be underestimated and like other subjects at the senior secondary school certificate level, 30 percent of the overall grade is based on the students' CASS practice while the remaining 70 percent constitutes the result from formal examination. Formal examination as a type of structured assessment is usually given at the end of the school term, or session or at the end of a course in a formal testing situation in which students are expected to work individually and for no reason should a student be assisted in the examination. An accurate examination of the students' rate of progress towards the attainment of desired learning objectives in STM could serve as a catalyst and as an aid for the teacher to assess his/her teaching strategy thus enabling adjustments to be made where necessary.

However, to successfully implement the structured assessment procedure in school, the STM teachers not only require ingenuity in structuring instruction, developing, adapting, obtaining and administering several instruments in order to gather comprehensive and cumulative information on the students [3] but ought to have developed the right type of attitudes toward assessment. Generally, STM teachers differ in the degree of their attitudes toward assessment practices in the school setting and this may precipitate STM teachers developing dimensions of attitudes towards structured assessment practices. Thus, the STM teachers' attitude towards the structured assessment practices may have an impact on students' learning. This is because attitudes of teachers towards assessment practices could be related to the teaching methods employed by these teachers [3] and teaching methods more often than not impact students' performance in STM [7, 8, 9, 10, 11]. While literature is replete with studies on the attitude of teachers towards STM and other school subjects [12, 13] very few studies investigated the attitude of STM teachers towards (structured) assessment practices. In this connection, [3] found that a greater proportion of integrated science teachers in their study seemed to exhibit positive attitudes towards most of the assessment practices, while significant sex and experience group differences were observed in the attitude of the teachers towards some assessment practices.

This study therefore, investigated the attitude of STM teachers towards various structured assessment practices. Such an investigation is vital because its results might provide an empirical basis for the development and improvement of assessment and evaluation methodology courses (tailored towards CASS and formal examination) in both pre-service and in-service training programmes for STM teachers. The main effects of gender, teaching experience, academic qualification, age and professional training on the STM teachers' attitude toward assessment practices were also examined.

II. METHODOLOGY

The sample consisted of 305 participants (165 science teachers: 105 males and 60 females; 100 mathematics teachers: 70 males and 30 females; and 40 technology teachers: 22 males and 18 females) from 171 senior secondary schools in three Local Government areas of Lagos state Nigeria. The three local government areas were randomly picked from 20 local government areas that make up Lagos State. In each local government area, the school sample was stratified across five political wards in such a way that one school was selected at random from every three in each ward. Not more than four science teachers, one mathematics teacher and two technology teachers per selected school responded to the questionnaire. The participants in a school were randomly selected if such teachers were more than four, one and two for sciences, mathematics and technology respectively in a

school, otherwise the only 1, 2, or 1, 2, 3 teachers for mathematics, technology and sciences respectively in a school picked responded to the questionnaire. Altogether, the sample consisted of STM teachers with varied years of STM teaching experience (Mean teaching experience = 8.16 years, standard deviation = 3.72). Their ages ranged from 20 to 60 years with a mean age of 40.14 years and a standard deviation of 6.78.

One instrument tagged STM Teachers' Attitude towards Assessment Practices Questionnaire (TATAPQ) adapted from [3] with slight modification in scaling was used for data collection in this study. The questionnaire composed of two sections: (a) demographic variables –age, gender, STM teaching experience, academic qualification and professional training and (b) consists of 26 statements made in various assessment practices, each on a five-point Likert scale in which teachers were required to indicate the extent of their agreement or otherwise to each of these statements). The validity and reliability of the instrument passed through two stages. First, the questionnaire items were vetted by a number of specialists in STM Education who found out that the questionnaire was content valid. Second, the content validated questionnaire was trial-tested using 50 STM teachers (25 from science, 15 from mathematics and 10 from technology) in 30 senior secondary schools in Calabar of Cross River, Nigeria. The analysis of the performance of the STM teachers on the items showed no ambiguity in the questionnaire, and produced a Cronbach coefficient alpha (for internal consistency reliability) of 0.875. The completion time for the 28 item questionnaire ranged between 12 to 18 minutes. The questionnaire was completed by the respondents under the guidance of the researcher and they were requested to indicate the extent of their agreement or otherwise on each of the assessment practices statements by marking on X on any of the scale points: Undecided (U); Strongly Disagree (SD); Disagree (D); Agree (A) and Strongly Agree (SA) in which U, SD, D, A, and SA attracted a scale value of 0, 1, 2, 3, and 4 respectively. Since the intervals on the Likert scale were not equal, only actual numbers and percentages of participants, selecting each scale point (for each statement) were computed to get a general pattern of STM teachers' attitude to assessment practices. The scales were interpreted in such way that positive views on any assessment practice reflect positive attitude towards such a practice and vice-versa. To find out whether gender, teaching experience or professional training group differences existed in the STM teachers' attitude towards assessment practices, the χ^2 statistics was computed.

III. RESULTS

A. General pattern of STM Teachers' Attitude to Assessment Practice

Table 1 below reveals the over-all picture of STM teachers' attitudes towards assessment practices. Actual numbers and percentages for responses to each statement are shown in the table. The percentages are in parenthesis. The table reveals that more than 60 percent of the STM teachers agreed/strongly agreed to such assessment practices, as post-testing students after teaching a new topic (item 2), giving examination and test scripts back to students after scoring (item 3), making students' test result part of students' terminal and annual examination results (item 5), using students' individual activities as templates for assessing students' STM progress (item 6), and gathering students' assessment data on STM using multiple choice test (item 18), essay tests (item 20), and laboratory practical (item 24). The table also shows that more than 50 percent of the STM teachers affirmed that STM teachers informing students at the beginning of the term about: the number of the examinations or tests scheduled for the term (item 9), the date for each test and examination (item 11), and the type of instruments to be used in each test and examination (item 12). In addition, more than half of the STM teachers agreed/strongly agreed to such assessment practices as making students' performances in STM tests and examination known to: other STM students in the school, parents of the students, all the teachers in.

TABLE I
GENERAL PATTERN OF STM TEACHERS' ATTITUDE TO ASSESSMENT PRACTICE

Item	SA	A	U	D	SD
Indicate the extent of your agreement or otherwise to each of the following assessment practices					
(1) Testing students before teaching a new topic	50 (16.4)	55 (21.3)	30 (9.8)	83 (27.2)	77 (25.2)
(2) Pre post testing students after teaching any topic	103 (33.8)	112 (36.7)	27 (8.9)	35 (11.5)	28 (9.2)
(3) Giving examination and test scripts back to students after scoring	111 (36.4)	108 (35.4)	27 (8.9)	32 (10.5)	27 (8.9)
(4) Students assessing their own STM progress	29 (9.5)	36 (11.8)	23 (7.5)	108 (35.4)	109 (35.7)
(5) Making students' test results part of students terminal and annual examination results	130 (42.6)	105 (34.4)	25 (8.2)	23 (7.5)	22 (7.2)
(6) Using students' individual activities as a template for assessing students' STM progress	132 (43.3)	72 (23.6)	45 (14.8)	24 (7.9)	32 (10.5)
(7) Using students' group activities as a template for assessing students' STM progress	79 (25.9)	38 (12.5)	25 (8.2)	58 (19.0)	105 (34.4)
(8) Using students' rating in assessing the teaching effectiveness of STM teachers	40 (13.1)	72 (23.6)	34 (11.1)	81 (26.6)	78 (25.6)

STM teachers informing students at the beginning of the term about:					
(9) The number of examinations or tests scheduled for the term	99 (32.5)	105 (34.4)	31 (10.2)	33 (10.8)	37 (12.1)
(10) The topics on which examinations and tests should be based	53 (17.4)	60 (19.7)	44 (14.4)	64 (21.0)	84 (27.5)
(11) The respective dates for each test and examination	102 (33.4)	84 (27.5)	40 (13.1)	50 (16.40	29 (9.5)
(12) The type of instruments to be used in specific tests and examinations (e.g. essay tests, multiple choice test, laboratory practical)	79 (25.9)	112 (36.7)	36 (11.8)	49 (16.1)	29 (9.5)
Making students performances in STM tests and examinations known to:					
(13) Other STM students in the school	109 (35.7)	104 (34.1)	26 (8.5)	39 (12.8)	27 (8.9)
(14) Parents of the students	113 (37.0)	71 (23.3)	25 (8.2)	60 (19.7)	36 (11.8)
(15) All the teachers in the school	187 (61.3)	65 (21.3)	16 (5.2)	18 (5.9)	19 (6.2)
(16) Administrators outside the school	70 (2.3)	115 (37.7)	44 (14.4)	46 (15.1)	30 (9.8)
(17) Auxiliary personnel in the school (e.g. laboratory assistants)	43 (14.1)	39 (12.8)	34 (11.1)	105 (34.4)	84 (27.5)
Gathering students' assessment data on STM using:					
(18)Multiple choice (objective) tests	137 (44.9)	91 (29.8)	23 (7.5)	26 (8.5)	28 (9.2)
(19)Observational instruments	26 (8.5)	45 (14.8)	112 (36.7)	61 (20.0)	51 (16.7)
(20) Essay tests	85 (27.9)	107 (35.1)	19 (6.2)	54 (17.7)	40 (13.1)
(21) Rating scales	31 (10.2)	43 (14.1)	110 (36.1)	77 (25.2)	44 (14.4)
(22)Sociometric instruments	42 (13.8)	61 (20.0)	118 (36.7)	53 (17.4)	31 (10.2)
(23) Projects	40 (13.1)	73 (23.9)	30 (9.8)	81 (26.6)	71 (23.3)
(24) Laboratory practical	108 (35.4)	97 (31.8)	28 (9.2)	36 (11.8)	36 (11.8)
(25) Structured quizzes	52 (17.0)	68 (22.3)	27 (8.9)	69 (22.6)	89 (29.2)
(26) Anecdotal records	33 (10.8)	45 (14.8)	125 (41.0)	58 (19.0)	44 (14.4)

As shown in Table 1 above, more than 50 percent of the STM teachers disagreed/strongly disagreed to such assessment practices as testing students before teaching a new topic (item 1), students assessing their own STM progress (item 4), using students' group activities as a template for assessing students' STM progress (item 7), using students' rating in assessing the teaching effectiveness of STM teachers (item 8), making students' test or examination results known to auxiliary personnel in the school (item 17), and gathering students' assessment data on STM using projects (item 23), and structured quizzes (item 25). The table also reveals that a greater proportion of the STM teachers (more than 36.0 percent) showed a neutral attitude to such assessment practices, as gathering students' assessment data on STM using observational instruments, sociometric instruments, and anecdotal records (item 19,22, and 26 respectively). Furthermore, more than 39.0 percent of the STM teachers disagreed/strongly disagreed to such assessment practices as gathering students' assessment data on STM using rating scales (item 21) and STM teachers informing students at the beginning of the term about the topics on which examination and tests should be based (item 10).

B. Group differences in Attitude towards Assessment Practices

1) Gender as a grouping factor: Male STM teachers were classified as group A while female STM teachers represented group B. There was a significant gender group difference on one item only. As shown in Table 2 below (item 8), a large proportion of male STM teachers were more inclined to express the view that ratings from STM students, should be used in assessing teaching effectiveness of STM teacher, while a larger proportion of female STM teachers would be more likely to object to such a practice.

TABLE 2
GENDER DIFFERENCES IN ATTITUDE OF STM TEACHERS WITH RESPECT TO ITEMS

Item No	**Gender Group**	**A/SA**	**U**	**D/SD**	**Total**	χ^2
8	A: Male	86	22	89	197	12.45*
	B: Female	26	12	70	108	
	Total	112	34	159	305	

*Significant at the .05 level (non-directional test)

2) Teaching experience as a grouping factor: Participants who do not have more than 9yrs of STM teaching experience where classified as group A, while those who have more than 9yrs of STM teaching experience formed group B. There were significant teaching experience group differences on two items only. As shown in Table 3 below (item 1), a greater proportion of participants in group B, were inclined to hold the view that tests should be administered to students before teaching a new topic, while a greater proportion of the group A participants would tend to objects to such a practice. The table (item 12) also shows that a larger proportion of group B STM teachers tended to express the view that STM should be informed at the beginning of the term about the type of instrument to be used in specific tests and examinations,

which a larger proportion of the group A participants would tend to object to such a practice.

TABLE 3
TEACHING EXPERIENCE GROUP DIFFERENCE IN ATTITUDE OF STM TEACHERS WITH RESPECT TO ITEMS 1 AND 12

Item No	Teaching Experience Group	A/SA	U	D/SD	Total	χ^2
1	A:1–9 years	29	15	65	109	9.86*
	B:More than 9 years	86	15	95	196	
	Total	115	30	160	305	
12	A:1–9 years	65	4	40	109	23.69*
	B:More than 9 years	126	32	38	196	
	Total	191	36	78	305	

*Significant at the .05 level (non-directional test)

3) Professional Training as a grouping factor: Professionally trained STM teachers formed group A, while STM teachers who have no professional training formed group B. There were significant group differences on two items only, as shown in Table 4. Results in the table reveal that a greater proportion of STM teachers in group A, unlike those in group B, were more inclined to hold the view that tests should be administered to STM students before teaching a new topic (item 1); and students' test results should form part of students' terminal and annual examination results (item 5).

TABLE 4
GROUP DIFFERENCES (BASED ON PROFESSIONAL TRAINING) IN STM TEACHERS' ATTITUDE TOWARD ASSESSMENT PRACTICES

Item No	Qualification Group	A/SA	U	D/SD	Total	χ^2
1	A: Professionally Trained	96	15	94	205	46.94*
	B:Non Professionally Trained	19	15	66	100	
	Total	115	30	160	305	
5	A: Professionally Trained	200	2	3	205	148.7*
	B: Non professionally Trained	35	23	42	100	
	Total	235	25	45	305	

*Significant at the .05 level (non-directional test)

IV. DISCUSSION AND CONCLUSION

The STM teachers who took part in this study seemed to hold positive attitudes toward such assessment practices as testing students after teaching a new topic, giving examination and test scripts back to students after scoring, making students' test results part of students' terminal and annual examination results, using students' individual activities as templates for assessing students' STM progress, and gathering students' assessment data on STM using multiple choice test, essay tests and laboratory practical. The STM teachers were also inclined to have positive attitudes toward such assessment practices as informing students at the beginning of the term about the number of examinations or tests scheduled for the term, the date for each test and examination and the type of instruments to be used in each test and examination. More so, the STM teachers tended to display positive attitudes toward such practices as making students' performances in STM tests and examinations known to other STM students in the school, parents of the students, all the teachers in the school, and administrators outside the school. These findings are very encouraging since they tend to be in line with the current educational system in Nigeria that is not in favour of determining the immediate educational future of the students by performance in one examination only. The continuous assessment of what the student has gained from STM learning activities in terms of finite skills inherent in the cognitive, affective, psychomotor and perceptual domains gives the teachers greater involvement in the overall assessment of their students. The positive attitudes toward such assessment practices as testing students after teaching any topic and making students' test result part of the students' annual and terminal examination results exhibited by the STM teachers in this study are in favour of the cumulative and periodic features of continuous assessment. The positive views of the STM teachers that test and examination scripts should be given back to students after scoring, and that students' performance in STM tests and examinations should be made known to parents, other students in the school, all the teachers in the school, and administrators outside the school are in favour of the guidance oriented characteristic of assessment. This is because these assessment practices are more likely to help the STM teachers in their efforts to guide students toward further academic success and enhanced career aspirations.

The comprehensiveness and systematic features of continuous assessment form the basis of testing for continuous assessment. These features, relied on such assessment practices as using multiple instruments to gather data from multiple sources, and informing students at beginning of the term about the number of examinations and tests scheduled for the term, the respective date for each test and examination, and the type of instruments to be used for the tests and examinations respectively. The positive attitudes shown by the STM teachers towards these assessment practices support the effective implementation of continuous assessment in STM. Thus, such assessment practices will aid the integration of the entire continuous assessment procedure (in this case formative) with instructional processes [3] in STM thereby promoting the role of continuous assessment as a tool for monitoring and enhancing students' learning outcomes. Effort should be made by the STM teachers in ensuring that the entire assessment procedures are in agreement with the instructional objectives of the STM Core–Curriculum. This is necessary in view of the fact that the type of assessment to be made, and the assessment instruments to be used during

instructional processes could drastically influence what is taught and what the students learn [3].

The STM teachers however, showed negative attitudes toward such assessment practices as testing students before teaching a new topic, students assessing their own STM progress, informing students at the beginning of the term about the topics on which examination and tests should be based, basing assessment of students progress on students' group activities, using students' ratings to assess teaching effectiveness of STM teachers, making students' performances in tests and examinations known to auxiliary personnel in the school, and using projects and structured quizzes to gather students' assessment data on STM. The STM teachers also tended to be neither positive nor negative in attitudes toward such assessment practices as using observational instruments, rating scales, sociometric instruments and anecdotal records to gather students' assessment data on STM. These findings indicated that the STM teachers are yet to fully appreciate the instructional role of continuous assessment and this could be much more disturbing when one considers the vital role of such assessment practices to a successful implementation of continuous assessment in STM. The systematic and guidance oriented nature of continuous assessment, underscore the need for in-service STM teachers to engage in the practice of informing students at the beginning of the term about the topics on which examinations and tests should be based, and that of making students' performances in tests and examinations known to auxiliary personnel in the school while the comprehensive nature of continuous assessment demands that STM teachers used the aforementioned assessment instruments to collect students' assessment data from multiple sources including students' self rating and students' group activities. Effort should be made to sensitize the STM teachers on the teaching-learning implications of such assessment practices as testing students before teaching a new topic, and using students' ratings to assess teaching effectiveness of STM teachers. These teachers should imbibe the idea of adopting pre-testing for placement evaluation and for determining the students' entry behaviour in a sequence of STM instructions. The practice of students assessing their teachers provides diagnostic feed-backs to teachers about the effectiveness of their teaching and may reveal (for the benefit of teachers) the criteria used by students in their rating of teachers [3]. Since continuous assessment is formative oriented, it is thus imperative that the STM teachers develop positive attitude towards pre-testing and students' evaluation of their teachers for improvement in teaching-learning process in STM.

The study also recorded significant gender difference in STM teachers' attitudes toward such assessment practices as using students' rating to assess teaching effectiveness of STM teacher. Significant effect of teaching experience was recorded on the STM teachers' attitudes to such assessment practices as testing students before teaching a new topic and informing students at the beginning of the term about the type of instruments to be used in tests and examinations. More so, significant effect of professional training was recorded on STM teachers' attitude toward such assessment practices as pre-testing students before teaching a new topic and making students' test results part of students' terminal and annual examination results. In a nutshell, the findings of the present study have indicated the following important characteristics of the attitudes of STM teachers toward assessment practices.

1. A higher proportion of the STM teachers seemed to display positive attitudes toward most of the assessment practice, while their attitudes toward some assessment practices tended to be either negative or neutral.
2. Gender, teaching experience and professional training could be factors in STM teachers' attitudes toward assessment practices.

Based on the above, it is suggested that training and retraining programmes for STM teachers on continuous assessment practices should be based on the predetermined attitudes of STM teachers toward the various assessment practices, and in situations where such attitudes tend to be negative or neutral, efforts should be made at directing the training programme towards effecting changes in the observed negative or neutral attitudes in such a way that the STM teachers, on completion of the training, would display positive attitudes that would conform to effective implementation of continuous assessment. Such efforts at promoting positive changes in the attitudes of STM teachers should bridge the gap of any gender, teaching experience and professional training differentials that may be detected in the teachers' attitudes toward assessment practices. In conclusion, attempts were not made (due to the nature of the research design) to offer plausible explanations for the significant gender, teaching experience, and professional training group differences detected in the study. Thus, future research may proffer explanations for these significant differences in STM teachers' variables on their attitudes toward assessment practices.

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