Assessing Assessment Literacy of Science Teachers in Public Secondary Schools in Ekiti State

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ABSTRACT

The study investigated assessment literacy of science teachers in public secondary schools in Ekiti State using survey design. Participants were 337 teachers (Male=152, Female=185) selected from 85 out of 184 public secondary schools in Ekiti State using stratified random sampling technique. Research instrument was a self-constructed questionnaire, 'Teacher's Assessment Literacy', having three sections: A, B and C. Section A was on biodata: gender (male/female) and teaching experience (in years) defined as 0—5 (low), 6—15 (average) and 16^+ (high). Section B contained 15 items multiple choice test of knowledge of assessment techniques with reliability coefficient=0.79 using KR-21 formula. Section C contained 20 items assessment techniques in which teachers were asked to indicate their degree of emphasis on each using a five-point scale: Always (5), Often (4), Sometimes (3), Rarely (2) and Never (1), with reliability coefficient=0.82 using Cronbach-α. Data were analysed using percentiles, means, standard deviations, t-test and one-way ANOVA tested at 0.05 level of significance. Results showed that majority of the teachers had low knowledge of assessment techniques. However, female teachers were more assessment-literate than males, while high experienced teachers were more assessment-literate than low and average experienced teachers. Moreover, teachers placed more emphasis on formal assessment procedures than the informal. It was recommended that regular seminar/workshop be organised for science teachers on assessment practices for quality assessment in the classroom.

Keywords: Assessing, Assessment literacy, Science teachers, Secondary schools

INTRODUCTION

The importance of assessment in the overall quality of teaching and learning in education has been widely acknowledged (e.g. Sadler, 1989; Black & Wiliam, 1998a; Brooks, 2002; Cruickshank, Jenkins & Mexcalf, 2009; Oluwatayo, 2009; Popham, 2009; White, 2012). For example, Cruickshank et al (2009) inform that quality assessment provides information about the effectiveness of instruction as well as helping both students and teachers make accurate determinations about what an individual student has or has not learned and why. Moreover, White (2012) describes assessment as an engine that drives learning noting that a well-designed assessment has the potential of setting clear expectations, establishing a reasonable workload and providing opportunities for students to self-monitor, rehearse, practice and receive feedback while a poorly designed assessment has the potential of hindering learning.

The literature on educational assessment is crammed full of assessment procedures that can be used to collect, synthesise and interpret information needed for decision making during teaching-learning process. These procedures range from ability tests such as achievement test that measures previous learning, aptitude test that measures potential for acquiring specific skill and intelligence test that measures potential to solve problems, adapt to changing circumstance and profit from experiences (Kaplan & Saccuzzo, 2005) to personality tests such as objective that provides a self-report statement to which a student can respond to and projective that provides an ambiguous test stimulus that requires non-specific responses (Neukrug & Fawcat, 2006) and informal assessment techniques such as observation that enables a teacher to identify, categorise and record behaviour in either a natural or a contrived situation and rating scale that enables a teacher to observe and indicate his or her evaluation of an observed behaviour or activity of a student during class lesson or practical period (Oosterhof, 2003). However, experts in this area (e.g. Mertler, 1999; Harlen, 2004) suggest the importance of using multiple assessment procedures to ensure that all students have the opportunity to show what they can do, noting that the greater the number of assessment procedures used in assessing an individual or a group of individuals, the greater the likelihood of obtaining a clear snapshot of the assessee(s).

Furthermore, Cruickshank et al (2009) point out that the effectiveness of an assessment depends upon the sources used to gain information and accuracy of the information. In science teaching, assessment procedures can be formal or informal depending on the purpose and criteria for selection and administration. Formal assessment involves scientific procedures which demand for soundness or validity and reliability (Webb, 1999;

Neukrug & Fawcett, 2006). Examples of formal assessment include tests of various forms: created response items (restricted or extended) which require the students to compose an answer, generally in their own words or selected response items (multiple-choice tests, matching items, true-false items, completion items) which require the students to select the appropriate answer from a list: quizzes, homework, project, performances (practical works) and others. The informal assessment procedures also require the procedures to yield valuable information though not as rigorous as the formal assessment (Neukrug, Lovell & Parker, 1996). Informal assessment procedures include observation, questionnaire, rating scales, checklists, anecdotal records, inventories, peer appraisal, portfolio and others.

The practical issue when trying to understand the efficacy of the various assessment procedures, however, centres on the assessor's assessment literacy. Assessment literacy in this context refers to the knowledge and skills acquired by an individual to identify and use the appropriate assessment techniques to gather accurate evidence of students' learning. According to Pophan (2009), assessment literacy is present when a person possesses the assessment-related knowledge and skills needed for the competent performance of that person's responsibilities including ability to define clear learning goals which are basis of developing or choosing ways to assess students' learning as well as knowing how to make use of a variety of assessment methods to provide accurate evidence of students' learning.

Interestingly, White (2012) suggests some desirable characteristics that an assessment literate educator should possess, including:
1.   superior knowledge about content and substance of what is to be learned;
2.   knowledge about learners and learning and a desire to help students develop, improve and do better;
3.   skills in selecting and creating assessment tasks;
4.   knowledge of criteria and standards appropriate to assessment tasks;
5.   evaluation skills and expertise in the analysis and use of assessment information, and
6.   expertise in giving appropriate targetted feedback.

One problem arising from the foregoing is the question of whether the present crop of teachers in the classroom are assessment literate to identify the appropriate assessment techniques needed for different situations and utilise them competently and comprehensively to provide quality teaching and learning, especially in the science class. The answer is conjectural.

Meanwhile, studies by Green & Mantz (2002), Bandele (2006), Stiggins (2006), Popham (2009), Kolawole (2010) and others indicate that many of today's teachers know little about educational assessment and hence lack competence in the use of assessment to motivate students for learning. Specifically, Green & Mantz (2002) report that most teachers do not use assessment strategies in their classrooms that are likely to improve instruction or students' learning. Their own work suggest that teachers feel comfortable using informal, formative types of assessment with their students such as observing students while working in groups and asking guiding questions thus thinking that such approaches allow them to provide students with feedback for improving their performance. In contrast, teachers indicate that they are not comfortable developing their own formal assessment to gauge students' learning nor having the confidence to use assessment results to improve their own practice.

Moreover, Bandele (2006), Stiggins (2006) and Pophan (2009) concur that many of today's teachers lack the knowledge and skills in assessment that can motivate students for learning because after completing their teacher educational programmes, they are hardly required to learn anything about educational assessment or educational evaluation besides what some of them might have been exposed to in their educational psychology classes or perhaps a unit in a methods class. Kolawole (2010) reports that most classroom teachers concentrate their assessment on cognitive aspect of learning objectives without much emphasis on affective and psychomotor domains of educational objectives thus leading to mere acquisition of knowledge without a corresponding acquisition of moral and practical development of the learners because they lack the knowledge and skills to identify, construct and use the appropriate assessment techniques in the classroom. It may be added also that when assessment involves the use of test, teachers hardly emphasise the higher order of cognition such as analysis, synthesis and evaluation but concentrate on the lower levels such as knowledge and comprehension or at times application which might have been responsible for poor performance of students in external examinations.

Pedagogically, it is expedient for every teacher, irrespective of gender, years of experience and subject area, to be assessment literate so as to be able to select the appropriate sources of information, ensure that his or her measurements and judgment are accurate and how and why he or she uses the assessment. The questions then remain: (1) Do the teachers have the knowledge of the various assessment techniques to enable them select the most appropriate ones in their science class? (2) How frequently do the teachers emphasise the various

assessment techniques in their science class? Undoubtedly, the outcome of this study would provide concise answers to the above questions.

Purpose of the Study

The purpose of the study was to assess the assessment literacy of science teachers in public secondary schools in Ekiti State in terms of knowledge and degree of emphasis on assessment techniques in the classroom as well as finding out whether teachers' gender and teaching experience would influence their assessment literacy.

Research Questions

The following research questions were raised to guide the study:
1.	What is the level of teachers' knowledge of the various assessment techniques?
2.	Which assessment techniques do the teachers emphasise in their science class?
3.	Does gender influence teachers' knowledge of assessment techniques?
4.	Does experience influence teachers' knowledge of assessment techniques?

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance.
HO_1:	Gender has no significant influence on teachers' knowledge of assessment techniques.
HO_2:	Experience has no significant influence on teachers' knowledge of assessment techniques.

METHODOLOGY

Research Design

The study was a survey type in order to describe the assessment literacy of science teachers in public secondary schools in Ekiti State.

Sample and Sampling Techniques

Participants were 337 science teachers selected from 85 out of 184 public secondary schools in Ekiti State using stratified random sampling technique. The strata recognised gender (Male=152, Female=185) and location of schools (urban=53 schools, rural=32 schools).

Research Instrument

The instrument for collecting data was a self-constructed questionnaire tagged 'Teacher's Assessment Literacy (TAL)', divided into three parts: A, B and C. Part A dealt with biodata of the respondents including gender (male/female) and years of teaching experience defined as 0—5 (low), 6—15 (average) and 16^+ (high). Section B contained 15 items multiple choice on knowledge of assessment techniques. Sampled items include:
1.	Which assessment instrument would you use to measure the amount of knowledge that a student has acquired in your subject at a specific time?
	(a) Intelligence test (b) Diagnostic test (c) Aptitude test (d) Achievement test
2.	Which instrument would you use to assess laboratory behaviour of your students during science practicals?
	(a) Mastery test (b) Observational technique (c) Personality test
	(d) Sociometric technique
3.	Which instrument would you use to report students' performance in relation to other students that do the task?
	(a) Criterion-referenced test (b) Inventory test (c) Norm-referenced test
	(d) Prognostic test

Section C contained 20-items on some assessment techniques in which the teachers were asked to indicate the degree of emphasis placed on each using a five-point scale, namely: Always=5, Often=4, Sometimes=3, Rarely=2 and Never=1. The face and consent validity procedures were ensured using experts in Tests and Measurement as well as Science Educators in the Faculty of Education, Ekiti State University, Ado-Ekiti. Separate reliability procedure was used for section B and C though copies of the instrument were administered once to respondents not included in the final analysis. The reliability coefficient for section B was estimated at 0.79 using Kuder-Richardson^{-21} formula (KR_{21}) while that of section -C was estimated at 0.82 using Cronbach -α.

Data Collection and Analysis

Data were collected using research assistants, mainly Postgraduate students in Tests and Measurement, Faculty of Education, Ekiti State University, Ado-Ekiti. Data collected were analysed using percentiles, means, standard deviations, t-test and one way Analysis of Variance (ANOVA), tested at 0.05 level of significance.

RESULTS AND DISCUSSION
Results
Question 1: What is the level of teachers' knowledge of assessment techniques?

Data were analysed using percentiles, having the range of values as follow: 0—5 (Low), 6—10 (Average) and 11—15 (High).

Table 1: Percentages of teachers' knowledge of assessment techniques

Range of Scores	N	%	Level
11—15	29	8.60	High
6—10	134	39.8	Average
0—5	174	51.6	Low
Total	337	100.0	

Maximum score = 15,   Minimum score = 0

Table 1 shows that 29 respondents, representing 8.6% scored between 11 and 15 inclusive in the test of knowledge of assessment techniques. 134 respondents, representing 39.8% scored between 6 and 10 inclusive while 174 respondents, representing 51.6% scored between 0 and 5 inclusive. These results showed that majority of the teachers had low knowledge of assessment techniques.

Question 2: What assessment techniques do the teachers emphasise in their science class?

Data were analysed using means and standard deviation (SD) with the assumption that the range mean scores between 1.0—1.49 (Never), 1.50—2.49 (Rarely), 2.50—3.49 (Sometimes), 3.50—4.49 (Often) and 4.50—5.0 (Always).

Table 1: Means and SD of teachers' emphasis on assessment techniques

S/N	Variables	Mean	SD	Frequency
1.	Created response (Essay)	3.57	0.83	Often
2.	True-False items	2.66	1.12	Sometimes
3.	Inventories	2.31	1.16	Rarely
4.	Multiple choice items	4.63	0.34	Always
5.	Checklists	1.46	1.25	Never
6.	Completion items	3.87	1.02	Often
7.	Short-answer items	4.42	0.46	Often
8.	Practical examinations	4.57	0.27	Always
9.	Peer rating	2.18	1.03	Rarely
10.	Self rating	3.24	1.41	Sometimes
11.	Projects	3.43	1.22	Sometimes
12.	Assignments	4.54	0.44	Always
13.	Matching series / Pairing items	3.58	1.14	Often
14.	Observational techniques	3.36	1.21	Sometimes
15.	Discussion	3.68	1.18	Often
16.	Interviews	2.47	1.31	Rarely
17.	Portfolio	2.11	0.87	Rarely
18.	Questioning	4.24	0.48	Often
19.	Anecdotal records	2.38	1.13	Rarely
20.	Open-book test	2.43	1.07	Rarely

Table 2 shows that teachers always emphasised multiple-choice items, practical examinations and assignment; often emphasised created response (essay), completion items, short-answer items, matching series, discussion and questioning; sometimes emphasised true-false items, self-rating, projects and observational techniques; rarely emphasised inventories, peer rating, interview, portfolio, anecdotal records and open-book test while never emphasised checklist. These results showed that teachers placed more emphasis on formal assessment techniques than the informal ones.

Hypotheses Testing
H0$_1$: Gender has no significant influence on teachers' knowledge of assessment techniques
Data were analysed using t-test comparison as presented in table 3.
Table 3: t-test comparison between male and female teachers' knowledge of assessment techniques

Variables	N	Mean	SD	df	t-cal	t-value
Male	152	6.25	1.79			
Female	185	8.40	2.15	335	10.05	1.96

$\rho < 0.05$ (Significant result) Maximum score = 15, Minimum score = 0

Table 3 shows that the mean scores and standard deviations of male and female teachers were 6.25 (1.79) and 8.40 (2.15) respectively. The t-test calculated was 10.05 while its corresponding table value at 0.05 level of significance was 1.96. Since $t_{cal} > t_{tab}$, it implies that significant difference existed between male and female teachers' knowledge of assessment techniques. By comparison, the female teachers had better knowledge of assessment techniques than the male teachers.

H0$_2$: Experience has no significant influence on teachers' knowledge of assessment techniques
Data were analysed using One-way Analysis of Variance (ANOVA) as presented in table 4.
Table 4: One-way ANOVA: Experience versus teachers' knowledge of assessment techniques

Source	SS	df	MS	F$_{cal}$	F$_{tab}$
Between Group	151.4	2	75.7		
Within Group	5644.6	334	16.9	4.47*	3.04
Total	5796	336			

$\rho < 0.05$ (Significant result)
$F_{(2,334)} = 3.04$

Table 4 shows that F-calculated was 4.47 while its corresponding table value at 0.05 level of significance was 3.04. Since $F_{cal} > F_{tab}$, it implies that significant difference existed in experience of teachers in relation to their knowledge of assessment techniques.

Table 5: Post-Hoc analysis using Scheffe comparison

N	Mean	Group	LE	AE	HE
13	6.47	LE			
209	6.80	AE			
115	8.25	HE	*	*	

* $\rho < 0.05$ (Significant result)Key:
LE = Low experience
AE = Average experience
HE = High experience

Table 5 shows that there was no significant difference between low and average experienced teachers in relation to knowledge of assessment techniques while significant difference existed between low and high as well as average and high experienced teachers regarding the knowledge of assessment techniques. These results showed that high experienced teachers had better knowledge of assessment techniques than low and average experienced teachers.

Discussion

The focus in this study was to assess the assessment literacy of science teachers as well as finding out the degree of emphasis they placed on various assessment techniques. Results in Table 1 showed that majority of teachers sampled had low knowledge of assessment techniques as 51.6% scored between 0 and 5 inclusive out of a maximum score of 15. This result concurs with the earlier findings by Bandele (2006), Stiggins (2006) and Pophan (2009) that many of today's classroom teachers have little knowledge of educational assessment because they are hardly required to undergo further assessment practices after graduation from their various institutions. This development is unhealthy to the growth of quality of science teaching and learning in schools since what the teachers assess are likely to be influenced by what they teach and the way they teach science. Beyond prejudice, teachers with little knowledge of assessment techniques are likely to be deficient in determining how and why they use assessment to monitor effectiveness of teaching and materials, select learning experiences, diagnose learning difficulties and guide learning in order to improve the instructional process. Conversely, teachers with high knowledge of assessment techniques are likely to be sensitive to why they should assess, how to assess, where to assess and what to assess in order to facilitate desirable teaching and learning as earlier informed by Cruickshank et al (2009) and White (2012).

Table 2 showed that teachers placed more emphasis on formal assessment such as tests more than informal assessments such as interview, portfolio, anecdotal records and others. These results tally with the earlier findings by Oluwatayo (2009) and Kolawole (2010) that teachers' assessment were skewedly titled to cognition at the expense of other domains such as affective and psychomotor. Unarguably, the inadequacy of emphasis placed on non-cognitive related assessment techniques by the teachers could limit the exposure of their students to varieties of assessment practices in schools, thus hindering their overall development scientifically. Indeed, the use of informal assessment such as anecdotal records, observations and interviews will likely allow teachers to know their students better, find out about their strengths and weaknesses, likes and dislikes, problems and successes.

Table 3 showed significant difference between male and female teachers' knowledge of assessment techniques as t-calculated=10.05 was greater than the t-table=1.96 at 0.05 level of significance. Further results showed that the males' scores ranged from 4.46 (4) to 8.04 (8) while females' scores ranged from 6.35 (6) to 10.55 (11). By comparison, female teachers had better knowledge of assessment techniques than male teachers. This result tallies with the findings of Derri et al (2012) that female teachers presented higher knowledge of assessment techniques than male teachers. The reason for the significant difference in the knowledge of assessment techniques between male and female teachers is not clear, may be the female teachers were able to recall some of the assessment techniques they were exposed to in Tests and Measurement course while in schools or mere guesswork. Notwithstanding, since the female teachers had better knowledge of assessment techniques, they are likely to be more concerned about academic progress of their students in terms of planning instruction, teaching and evaluating learning outcomes.

Table 4 showed significant difference in the knowledge of assessment techniques among low, average and high experienced teachers as $F_{calculated}$=4.47 was greater than the F_{table}=3.03. Further analysis using Scheffe comparison showed high experienced teachers had better knowledge of assessment techniques than their low and average experienced teachers. This is not surprising because similar research in this area, Mertler (2004) reported that high experienced teachers were more assessment literate than the low experienced teachers. Indeed, having adequate knowledge of the various assessment techniques is likely to help teachers plan, select and use the appropriate assessment strategies to thoughtfully guide collection of data necessary for decision making regarding teaching and learning in schools. Pophan (2009) notes that teachers who want to be optimally effective ought to be learning about the essentials of classroom assessment for a long while to come.

Conclusion

The study concluded that the low level of assessment literacy exhibited by the majority of the science teachers was inimical to the growth of quality science teaching and learning in schools since, unarguably, what teachers assessed would likely be influenced by what they taught and the way they taught. Moreover, the inadequacy of emphasis the teachers placed on non-cognitive related assessment techniques was an indication of their ability to identify and administer quality assessment techniques that could facilitate the overall development of the students in terms of cognitive, affective and psychomotor domains. However, the fact that the female teachers demonstrated better knowledge of assessment techniques than their male counterparts was an indication of their greater commitment to quality science teaching and learning in schools.

Moreover, the fact that the high experienced teachers had better knowledge of assessment techniques than their low and average experienced teachers was an indication of their higher commitment to quality assessment practices in secondary schools.

Recommendations

Based on the conclusion of this study, it was recommended that:

1. Ekiti State Ministry of Education, Science and Technology Division should, as a matter of necessity, organise seminar/workshop for science teachers on assessment literacy to enhance quality educational assessment in secondary schools.

2. Science teachers should be sensitised on the need to comprehensively emphasise both formal and informal assessment techniques for the overall development of the students in terms of cognitive, affective and psychomotor domains.

3. Both male and female science teachers should get themselves acquainted with relevant textbooks on assessment techniques so as to guide them in identifying, planning, constructing and administration of appropriate assessment tools for better performance of their duties in term of teaching and assessment of students' learning outcomes.

4. Experienced teachers should mentor those low experienced teachers in terms of assessment practices to enable Ekiti State achieve her developmental educational goals in terms of science and technology.

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