JOURNAL OF MULTIDISCIPLINARY RESEARCH AND DEVELOPMENT | ISSN 3031-9390
Vol. 2, No. 2, 2025, 171-187
https://doi.org/10.56916/jmrd.v2i2.1206

Impact of Teachers' Assessment Practices on Students' Attitude and Critical Thinking in Basic Science

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Keywords
Attitude
Basic Science
Critical thinking
Gender
teachers' assessment practices

Article History
Received 2025-04-01
Accepted 2025-06-17

Abstract
This study investigated impact of teachers' assessment practices on students' attitude and critical thinking in Basic Science using cross-sectional survey research design. A sample of 393 from a population of 20,885 students using multi-stage sampling procedure participated. Three instruments: Basic Science Critical Thinking Test (BSCTT), Basic Science Students' Attitude Scale (BSSAS), and Basic Science Teachers' Assessment Practices Observation Scale (BSTAPOS) with reliability coefficients of .60, .71 and .66 respectively aided data collection. Based on data analysis, it was found that a significant difference exists in the impact of teachers' low, moderate and high classroom assessment practices on the mean attitude ratings [$F(2,392) = 71.483$, $p = .000 < .05$], mean critical thinking scores [$F(2,392) = 65.023$, $p = .000 < .05$] of students in Basic Science. Male and female students do not differ significantly on the impact of teachers' low and moderate assessment practices but with high assessment practice on attitude, and also do not differ significantly regarding critical thinking scores in Basic Science. To reduce the incidence of Basic Science teachers' low and moderate assessment practices, teachers are encouraged to use high classroom assessment practices.

INTRODUCTION

There are dimensions of assessment practices among teachers in Science which include types of assessment, assessment methods, the frequency of assessment, alignment with learning objectives, feedback mechanism, technology integration, collaboration, authenticity and adaptability. The current trend focuses on ensuring assessments align with specific goals and leveraging digital tools to enhance assessment efficiency and effectiveness (Gibson & O'Connor 2023). In types of assessment, teachers may use a combination of formative assessment (quizzes, homework, classwork) and summative assessment (SA) (exams, projects, presentations) to evaluate learning. Formative assessment (FA) is a pivotal and valid part of integrating assessment and teaching (Ozan & Kensal, 2018). These practices help in effectively tracking student's progress and enhancing instructional delivery (Jones & Lee, 2021)

Educators like Earl (2013), Tadessse and Dereje (2021) see assessment as a means for measuring the outcomes of learning and it is regarded as a summative assessment. However, there has been a paradigm shift and the scope of assessment is being widened to cover not only students' learning outcomes at the end of a specific period to decide who passes or fails, but also to enhance learning by modifying classroom instruction. This is exactly what assessment for learning(AfL) does as it aims to improve the quality of teaching and assessment results to change students' learning.

Assessment as a process of learning, AfL as well as assessment of learning (AoL) outcomes has integral roles to play in achieving set objectives of a school subject. In other words, the credibility of any educational enterprise to a large extent depends on the quality of assessment practiced by the teachers. To this end, no educational system can survive without classroom assessment of learning experiences be it AoL is more than giving marks or grades based on assessment practiced by the teacher using different techniques. Owodunni (2019), examined the practices of School-based assessment techniques in science classes and found that the practices of School-based assessment techniques place high demand on the teachers since assessment is built into the teaching and learning process. It provides teachers and learners with necessary information about the extent to which educational objectives have been achieved in basic science(BS) classes.

However, without appropriate assessment practices in classes, the objectives of teaching and learning BS cannot be achieved. This makes it mandatory for the content of the curriculum, the instructional/behavioural objectives, and the processes and methods of assessment to be closely linked as this could provide leeway for the BS teachers to regularly assess students. Unfortunately, Nigeria's present education system may be considered as an Examination-Based System. This is where only one short examination is given to test the cognitive domain and is used to decide the fate of a student who may have studied for three years without any serious assessment of components of the affective domain like attitude (Nworgu & Ellah, 2015).

Attitudes are complex constructs that influence how individuals think, feel and believe in various contexts, including educational settings. Personal experiences, social influences and educational interventions are factors that significantly impact students' engagement and learning outcomes (Furlong & O'Connor, 2019). Attitudes are formed by people arising from learning experiences; if the experience is pleasant, a positive attitude is found and vice versa (Orunaboka, 2011). The attitude people hold often influence the way they act in person and respond to larger situations. This informs why attitude development, how it affects behaviour and how it can be changed is important.

Attitude does not only include the negative stance such as prejudices, biases and dislikes, but also positive mind-set that are sometimes called sentiments, which include ones attachment and loyalties to persons, objects and ideas (Sakariyau, Taiwo & Ajagbe, 2016). Some attitudes are based on experiences, some are gained from other sources, yet others come from knowledge and skills. However, attitude does not stay the same but changes a couple of times and it is gradual (Olasheinde & Olatoye, 2014). Attitude is, therefore, a major factor in a subject choice. Making learners develop positive attitudes towards Basic Science which has remained a subject of concern has a link to students' critical thinking.

Critical thinking is considered one of the most important skills in 21st-century learning, as it is one of the capitals of success in the workplace (Saavedra & Opfer, 2012). Critical thinking is an active intellectual process that is skillfully formulating concepts, applying, analyzing, synthesizing and evaluating the information collected. This whole process can be obtained from observation, experience, reflection, reasoning and communication (Ennis, 2016). Samba et al (2020) examined how

graphic organizer and experiential learning with feedback affect the mean achievement and students' critical thinking in Jos North Local Government Area of the Plateau State of Nigeria and found that experiential learning with feedback enhanced students' critical thinking in BS.

Critical thinking is related to one's ability to think rationally, that is, being able to think to solve problems by engaging reasons that come from knowledge in the form of facts and information stored in the thought. It is also a cognitive activity related to the use of the mind. Thinking critically, analytically, and evaluatively means using mental processes such as attention, categorization, selection, and judgment (Cottrell, 2017; Abakpa, Agogo & Imoko, 2022; Achor & Bileya, 2022). The development of higher order critical thinking is important because it plays a role in building the various possible answers needed to solve increasingly complex problems. The ability to think critically is vital in making the right decision based on facts and strong reasons, which are needed in work and everyday life (Vong & Kaewurai, 2017).

Critical thinking is rewarding in many ways: 1) improves the ability to observe; 2) focus more when reading; 3) improves the ability to identify important points in the text; 4) know how to acquire knowledge; 5) analytical skills can be applied to different situations (Cottrell, 2017). However, these skills are not necessarily possessed by students as Nuryanti, Zubaidah and Diantoro (2018) found that students' critical thinking skills are still poor with the percentage of students answering questions in the correct category only at 40.46%. Good critical thinking skills in a learning environment can have good implications for science learning.

About the gender of students in secondary schools, Achor, Odoh and Abakpa (2018) declare gender as a wing of social organization that moderates people's interaction with others, their behaviour or act and how they think about themselves. Ajayi (2019), states that gender is socially constructed to allocate powers, duties, responsibilities, status and roles in any social context. This is more than biological differences but includes the ways in which these differences, whether real or perceived are valued, used and relied upon to classify men and women as well as for assignment of roles and expectations. The difference in Basic Science performance due to gender as reported by Okoye (2014) is a source of concern to educationists.

Gender related issues are common place in the Nigerian society as reported by Ewumi (2012). There are reported cases of whether or not gender has any impact whatsoever, on students' attitude and critical thinking in Basic Science and Technology(BST). Yet no consistent conclusion has emerged. Further, Olasehinde and Olatoye (2014) advanced from their study that females are not so efficient in science because they are less analytical and in visual spatial skills that define abstract reasoning in science. The authors, in literature contrary to earlier finding, have expressed that some researchers reported that girls exhibit better learning outcome than boys in some instances. It remains unclear how teachers' assessment practices either enhance or hinder students' attitude and ability to think critically in the scientific context. The inconsistency in research reports suggests that study on the enhancing students' attitude and critical thinking in Basic Science using teachers' assessment practices deserve research attention. Specifically, Reports in this study addressed:

1) the impact of different levels of Teachers' Classroom Assessment Practices on students' attitude towards BS.
2) the impact of different levels of Teachers' Classroom Assessment Practices on students' critical thinking.
3) the impact of different levels of Teachers' Classroom Assessment Practices on students' attitude towards BS based on gender.

4) the impact of different levels of Teachers' Classroom Assessment Practices among male and female students' critical thinking in BS.

LITERATURE REVIEW

Theoretical Framework

The following theories give anchorage to this study. They are Sadler's theory of assessment (1983), Barnett's theory of critical thinking (1977) and Bandura's (1977) theory of attitude. Sadler (1983) states that academic learning takes place when a person knows what is to be achieved, works towards ways of doing it, and can tell when progress is being made. Students often perceive assessment as difficult and threatening. As a result, for assessment to be congenial, the assessment ought to take place in an open environment where the teacher considers the difficulty the students face during assessment and where the student appreciates the need for assessment in teaching and learning situations. Assessment is the process of determining the gap between learner knowledge and skills and the intended learning outcome A good assessment gives a good image of the teacher as the unquestionable authority. It recognizes the importance of creative discourse among teachers and students. Sadler proposed three principles for better formative assessment and they include: the communication principle, the progressive principle and the iteration principle.

This theory is relevant to this study because it emphasizes the need for peer and self-assessment as well as providing feedback for students after assessment. When opportunities and incentives to rework and resubmit papers are engaged, with continuous rather than single-shot access to evaluative feedback, students and the teacher can work on strengthening areas of weakness for improved performance in the future. If meaningful learning is to take place in Basic Science, the teacher has a dual role of deploying formative and peer assessment of learning experiences in order to improve students' performance including helping the student develop critical thinking and science process skills through practical tasks and experiences. Through this process, students are able to learn about themselves as learners and become aware of how they learn – become metacognitive (knowledge of one's thought processes). Students reflect on their work regularly, usually through self and peer assessment and decide (often with the help of the teacher, particularly in the early stages) what their next learning will be.

Assessment as learning helps students to take more responsibility for their own learning in Basic Science while assessment for learning occurs throughout the learning process. It is interactive, with BS teachers aligning instruction, identifying particular learning needs of students, selecting and adapting materials and resources and creating differentiated teaching strategies and learning opportunities for helping individual students to think critically to improve performance including developing a positive attitude to learning of BS. By providing immediate feedback and direction to students, Basic Science teachers can also use assessment of learning to enhance students' motivation and commitment to learning. When teachers see learning as the focus of assessment, they change the classroom learning experiences to practical ones that foster the acquisition of science process skills and make students successful in learning BS.

Bandura's social learning theory was propounded in 1977. The theory posits that people learn from one another, via observation, imitation, and modeling. The theory has often been called a bridge between behaviourist and cognitive learning theories because it encompasses attention, memory, and motivation. The basic principles of the theory are as follows:

1. Learning would be exceedingly laborious, not to mention hazardous, if people had to rely solely on the effects of their own actions to inform them of what to do.

2. Most human behaviour is learned observationally through modeling. The component processes underlying observational learning include: (a) attention, including modeled events (distinctiveness, affective valence, complexity, prevalence, functional value) and observer characteristics (sensory capacities, arousal level, perceptual set, past reinforcement); (b) retention, including symbolic coding, cognitive organization, symbolic rehearsal, motor rehearsal; Motor reproduction, including physical capabilities, self-observation of reproduction, accuracy of feedback; and (c) motivation, including external, vicarious and self-reinforcement.
3. Human behaviour can be explained in terms of continuous reciprocal interaction between cognitive, behavioural and environmental influences;
4. The highest level of observational learning is achieved by first organizing and rehearsing the modeled behaviour symbolically and then enacting it overtly. Coding modeled behaviour into words, labels or images results in better retention than simply observing;
5. Individuals are more likely to adopt a modeled behaviour if it results in outcomes they value;
6. Individuals are more likely to adopt a modeled behaviour if the model is similar to the observer and if it has an admired status and the behaviour has functional value.

Bandura's theory likened human behaviour to that of atoms which were originally unaltered until a chemical reaction resulted in their rearrangement. Similarly, the effect of models like the chemical reaction alters the behaviour, especially of children from its original state towards that of the model. This linkage forms the foundation of behaviourist learning theories.

Bandura's attitude theory is relevant to this study because it provides the latitude in the behaviour of the students which can be leveraged upon to make the learning of BS easier and more interesting. If BS teachers' assessment practices are not fearsome and abstract, but fun-filled and practical, students will perceive the subject in same light and consequently develop positive attitudes towards the learning of the subject. This theory is related to the present study since it focuses on how children learn from and copy the attitude of the people around them. This means that students' attitudes can be formed as a result of teachers' behaviour. Thus, the attitudes of students towards BS may result from the inter-personal behaviour between BS teachers and the students during classroom assessment. Bandura's social learning theory is relevant to teachers assessment practices in BS as it underscores the importance of modeling positive attitudes and providing feedback. By demonstrating enthusiasm and confidence in science and by offering supportive assessment, teachers can positively influence students' attitudes and motivation towards BS.

Barnett's (1977) theory of critical thinking aims to promote critical thinking as a fundamental aspect of education, personal growth and decision making which involves questioning, assumptions, exploring alternatives and examining evidence. Barnett (1977) argues that critical thinking must be contextually dependent and suggests that there are three domains of critical thinking, namely:

1. Knowledge - propositions, ideas and theories, especially as they are proffered in the world of systematic knowledge;
2. Self - the internal world, that is oneself, a form of critical thought that is demonstrated in critical self--reflection;
3. World - the external world, a form of critical thought that is demonstrated in critical action.

Barnett (1977) presents four levels of criticality, ranging from critical skills to transformatory critique and explains that critical thinking is on the character of the individual's cognitive acts, which can take the form of cognitive processes and variety of skills. Barnet's theory of critical thinking emphasizes the importance of teaching students to question and evaluate information effectively. In assessment practices for basic 2 students, this theory is relevant as it encourages the design of

assessment that promotes and evaluates student's ability to think critically rather than just recall facts, fostering deeper understanding and problem solving skills.

Empirical Review

Achor and Ejeh (2019) assessed the effect of Cognitive ability and Achievement level of some Nigerian Students in Home Economics using Cognitive Acceleration Training Programme. Three research questions guided the study and three hypotheses were tested at .05 level of significance. The findings revealed that students who were exposed to the Cognitive Acceleration Training Programme (CATP) in addition to the conventional strategy of teaching exhibited higher achievement (1,379=214.961, p=0.00). It is found that students with low cognitive ability level benefited more from CATP. There is no significant difference in the mean gains in cognitive ability and achievement scores among low, moderate and high cognitive ability students exposed to cognitive acceleration training program (*F*2, 211=2.975, *P* = .05; *F*2, 211 = 5.75).

Achor, Agogo and Duguryl (2015) carried out a study on the effect of cognitive reasoning ability and prior exposure to content on Upper Basic two students' achievement in BS. The study proposed 3 research questions and 4 hypotheses that guided the study. The findings revealed that prior exposure of students to the content of BS significantly improved achievement. Similarly, the achievement of high and low reasoning ability level of students significantly differs in favor of high-ability students. The study also found that male and female students exposed to content before instruction do not significantly differ in their achievement.

Achor, Agogo and Duguryil (2015) addressed the effect of cognitive reasoning ability and the prior exposure to content on upper Basic two (8^{th} grader) students' retention in BS in Plateau state, Nigeria. Three research questions and three hypotheses guided the study; the non-equivalent control group, pre-test, post-test design was used for the study. The findings revealed that prior exposure of students to contents of BS significantly improve retention. Similarly, knowledge and retention of high and low reasoning ability level students significantly differed in favor of high ability students. The study also found that male and female students exposed to content prior to instruction do not differ significantly in their knowledge retention. However, there was a significant interaction effect of method, gender and reasoning ability on students' retention in BS. It was concluded that prior exposure to content enhanced students retention and that high ability students retained more of science learnt compared to low ability students.

Anyawu, Ezenwa and Gambari(2014)investigated bridging gap between the low, medium and high ability students through the use of computer-based multimedia instruction in Minna Local Government Area, Niger State, Nigeria. Three research questions and three hypotheses guided the study. The researcher adopted a pre-test, post-test experimental design. The findings showed that, there is significant difference (P<0.5) in the post-test Mean score of AT, AN and the conventional groups favoring AN. Also, no significant difference was found in the post-test Mean scores of High, Medium and Low ability students taught using AT.

Yaduvanshi and Singh (2019) carried out a study on fostering achievement of Low Achievers, Average Achievers and High Achievers students in Biology through Structured Cooperative Learning (STAD method) in India. The study revealed that low achievers, Average Achievers and High Achievers students of the experimental group outperform the control group.

Ozan and Kincal (2018) examined the effects of formative assessment practices on students' academic achievement, attitudes toward lessons, and self-regulation skills in the fifth-grade Social Studies class. Mixed method research was used to conduct the study. As a result of the research, it was

determined that the experimental group in which the formative assessment practices were performed had significantly higher academic achievement levels and better attitudes toward the class than the students in the control group. Regarding the students' self-regulation skills, although the formative assessment had a positive effect, no significant difference was found between the experimental and control groups. According to the researcher's observations and the interviews conducted with the teacher and students, it was determined that the general view on the application of formative assessment was notably positive.

Seyed, Rahul, Indrajit and Ehsan (2022) explored the formative vs. summative assessments: On academic motivation, attitude toward learning, test anxiety, and self-regulation skill. 72 Iranian EFL learners were chosen and assigned to two experimental groups (Summative Group and Formative Group) and a Control Group. The outcomes of one-way ANOVA and Bonferroni tests revealed that both summative and formative assessments were effective but the formative was more effective on academic motivation, test anxiety, and self-regulation skill. The findings of one sample t-test indicated that the participants had positive attitudes toward summative and formative assessments.

Musa, Ode, Ona and Gandepuun (2023) investigated the effect of multimedia instructional strategy on students' critical thinking and attitude toward BS. Quasi experimental research design was employed for the study. The findings of this study revealed significant difference in the mean critical thinking scores of students taught BS using multimedia instructional strategy and conventional strategy. Similarly, significant difference in the mean attitude ratings of students taught BS using multimedia instructional strategy and conventional strategy was found.

Terhemba, Ayua and Ikyernum (2022) examined the effect of creative teaching on critical thinking among different- ability Upper-Basic Science students in Gboko-town. Findings showed no significant difference in the critical thinking level among different-ability students taught BS using lecture method and those taught using creative teaching $F(2, 63) = 1.24$, $\rho = .30 > .05$. Although, there existed a significant difference in critical thinking level in favor of those taught using creative teaching $F(1, 63) = 49.89$, $p = .00 < .05$, no significant difference existed in the students' critical thinking level based on gender $F(2, 28) = 2.50$, $\rho = 2.50 > .05$. By implication, the level of critical thinking among different-ability students can be enhanced without gender disparity if learners are actively engaged in the creative teaching.

Samba, Achor, Bash and Iortim (2020) carried out a study on fostering students' critical thinking and achievement in BS using graphic organizer (GO) and experiential learning (EL) with feedback on the mean achievement and students' critical thinking in Jos North Local Government Area of the Plateau State of Nigeria. Results revealed that students taught using GO had a mean gain of 12.99 while students taught using EL had a mean gain of 12.02 in the BSTAT. ANCOVA analysis of post-test mean scores in the BSTAT, F (1, 58) = 1.282, $\rho > .05$, was not significant. Furthermore, ANCOVA analysis between mean post-test scores of the CTT for GO and EL groups F (3, 81) = 2.236, $\rho > .05$, was not significant. GO an EL with feedback strategies enhanced students' achievement and critical thinking with GO being slightly superior.

METHODS

Design, Population and Sample

A research design of a cross-sectional survey type was adopted for the study. This design allows data to be collected at a single point in time from a representative sample using minimum time and resources. The population of the study comprised 20,885 students from 531 Schools in the Kogi East Education zone, Nigeria for the 2023/2024 Academic Session. The sample for this study was 411

respondents. The sample size was obtained using the Taro Yamane formula. A multi-stage sampling procedure was employed.

Instruments

The instruments used are the Basic Science Teachers Assessment Practice Observation Scale (BSTAPOS), Basic Science Students' Attitude Scale (BSSAS) and Basic Science Critical Thinking Test (BSCTT)

The Basic Science Teachers Assessment Practice Observation Scale (BSTAPOS) was adapted by the researcher from the Benue State University Makurdi Student Teaching Practice Evaluation form and the National Commission for Colleges of Education (NCCE) Teaching Practice Form. The BSTAPOS comprises two sections, A and B. Part A sought demographic information from the respondents while Part B contains 20 items that measure Assessment Practices used by Basic Science teachers. The Basic Science Students' Attitude Scale (BSSAS) was adapted by the researcher from the Test of Science-Related Attitudes (TOSRA). The BSSAS contained A and B components. Component A seeks demographic information of the students and component B contains 24 items rating scale which requires students to indicate their position on each statement on a four-point scale consisting of the response Strongly Agree (SA = 4), Agree (A = 3), Disagree (D = 2) and Strongly Disagree (SD = 1).

The Basic Science Critical Thinking Test (BSCTT) was constructed by the researchers. BSCTT had sections A and B. Sections A was to elicit demographic information of the students while B component contains 10 items constructed based on students' use of Basic Science Mental Effort or Category of Critical Thinking in learning basic science principles and concepts. The BSCTT measures students' critical thinking outcome.

Validation and Reliability of Instruments

Face validation was done for BSTAPOS), Basic Science Students Attitude Scale (BSSAS and BSCTT by three experts. Content validation was done for BSSAS. Item analysis was carried out on the BSSAS for students in the Basic Education schools to establish its construct validity. Construct validation was done for BSSAS using factor analysis. This is based on the extraction method of principal component analysis. The rotation method of Varimax with Kaiser normalization was used. The reason for the choice of construct validation is because students' power to think consists of several almost uncorrelated functioning parts known as factors which could be identify through a technique known as factor analysis.

The item selection was done using the item selection matrix obtained from rotated component matrix. The factor loading of .30 and above on any of the factors or items were identified and selected to be part of the final form of the BSSAS for students in the Basic Education schools and those that fail to load up to .30 are discarded, thus only 24 items survived out of 30.

The instruments BSSAS and BSCTT were trial tested on 40 upper Basic II science students in two schools while BSTAPOS were trial tested on 10 BS teachers in five schools in the study area that were not sampled in the study in order to determine the reliability coefficient of the instrument. The reliability coefficient of BSCTT was analyzed using Kuder-Richardson formula-21 ($K\text{-}R_{21}$) and found to be .60 while the reliability index of BSSAS was analysed using Cronbach Alpha and found to .71. The reliability coefficient of BSTAPOS was analysed using Spearman Rank Correlation and found to be .66.

Data Collection and Analysis

The instruments were personally administered on the respondents by the researcher with the assistance of the BS teachers in the sampled schools to ensure high rate of return of the instruments.

Mean and standard deviation were used to answer all the research questions. The null hypotheses were tested using independent t-test and Analysis of Variance (ANOVA) at .05 level of significance.

RESULTS

Results are presented in tables in line with the earlier stated objectives.

Table 1. Mean Attitude of Students Due to Teachers' Low, Moderate and High Classroom Assessment Practices

Classroom Assessment Practices	N	Mean	SD	Std. Error
Low Assessment Practices	80	2.16	.88	.09
Moderate Assessment Practices	213	2.76	.40	.02
High Assessment Practices	100	3.23	.64	.06
Total	**393**			

Note: N = number of students , SD = *standard deviation*

Table 1 revealed that there were low classroom assessment practices with 80 students, moderate classroom assessment practices with 213 students and high classroom assessment practices with 100 students. The table further shows that students with low classroom assessment practices had a mean attitude rating of 2.16, standard deviation of .88 while students with moderate classroom assessment practices had a mean attitude rating of 2.76, a standard deviation of .40 and students with high classroom assessment practices had mean attitude rating of 3.23 with a standard deviation of .49.

Table 2: Mean Critical Thinking of Students Due to Teachers' Low, Moderate and High Classroom Assessment Practices

Classroom Assessment Practices	N	Mean	SD	Std. Error
Low Assessment Practices	80	3.01	3.46	.38
Moderate Assessment Practices	213	3.01	2.89	.19
High Assessment Practices	100	7.32	3.78	.37
Total	**393**			

Table 2 shows that there were low classroom assessment practices with 80 students, moderate classroom assessment practices with 213 students and high classroom assessment practices with 100 students. The table further shows that students with low classroom assessment practices had mean critical thinking scores of 3.01, standard deviation of 3.46 while students with moderate classroom assessment practices had mean critical thinking scores of 3.01, a standard deviation of 2.89 and students with high classroom assessment practices had mean critical thinking scores of 7.32 with a standard deviation of 3.78.

Table 3: Mean Attitude of Male and Female Students Due to Teachers' Low, Moderate and High Classroom Assessment Practices

Students' Attitude Ratings in Basic Science	Classroom assessment practices								
	Low			Moderate			High		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Male	43	2.69	.45	118	2.75	.39	55	3.07	.62
Female	37	2.76	.20	95	2.70	.34	45	3.35	.57
Mean differ		0.07			0.05			0.28	

Table 3 revealed that there were low classroom assessment practices with 43 male and 37 female students, moderate classroom assessment practices with 118 male and 95 female students and high classroom assessment practices with 55 male and 45 female students. The table further shows that male students with low classroom assessment practices had mean attitude ratings of 2.69, standard deviation of .45 and female students with low classroom assessment practices had mean attitude ratings of 2.76 with a standard deviation of .20. Similarly, male students with moderate classroom assessment practices had mean attitude ratings of 2.75, standard deviation of .39 and female students with moderate classroom assessment practices had mean attitude ratings of 2.70 with a standard deviation of .34. Again, male students with high classroom assessment practices had mean attitude ratings of 3.06, standard deviation of .62 and female students with high classroom assessment practices had mean attitude ratings of 3.35 with a standard deviation of .57.

Table 4. Mean Critical Thinking of Male and Female Students due to Teachers Low, Moderate and High Classroom Assessment Practices

Students' critical thinking scores in Basic Science	**Classroom assessment practices**								
	Low			**Moderate**			**High**		
	N	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**
Male	43	2.98	4.25	118	2.91	2.74	55	7.43	3.66
Female	37	3.11	2.21	95	3.18	3.06	45	7.12	3.74
Mean differ		-0.13			-0.27			0.31	

Table 4 shows that there were low classroom assessment practices with 43 male and 37 female students, moderate classroom assessment practices with 118 male and 95 female students and high classroom assessment practices with 55 male and 45 female students. The table further shows that male students with low classroom assessment practices had mean critical thinking scores of 2.98, standard deviation of 4.25 and female students with low classroom assessment practices had mean critical thinking scores of 3.11 with a standard deviation of 2.21. Similarly, male students with moderate classroom assessment practices had mean critical thinking scores of 2.91, standard deviation of 2.74 and female students with moderate classroom assessment practices had mean critical thinking scores of 3.18 with a standard deviation of 3.06. Again, male students with high classroom assessment practices had mean critical thinking scores of 7.43, standard deviation of 3.66 and female students with high classroom assessment practices had mean critical thinking scores of 7.11 with a standard deviation of 3.74.

Table 5. ANOVA of Impact of Teachers' Low, Moderate and High Classroom Assessment Practices on Attitude Ratings of Students

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	50.59	2	25.30	71.48	.00
Within Groups	138.01	390	.35		
Total	**188.60**	**392**			

Table 5 reveals that $F(2,392) = 71.48$; $p = .00 < .05$. The null hypothesis is rejected. This means that there is a significant difference in the impact of teachers' of low, moderate and high classroom assessment practices on the mean attitude ratings of students in BS.

Table 6. Multiple Comparisons of Impact of Teachers' Low, Moderate and High Classroom Assessment Practices on Attitude Ratings of Students

Scheffe

(I) Low, Moderate, and High Classroom Assessment Practices	(J) Low, Moderate, and High Classroom Assessment Practices	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Low Assessment Practices	Moderate Assessment Practices	-.60*	.08	.00	-.79	-.41
	High Assessment Practices	-1.07*	.09	.00	-1.29	-.85
Moderate Assessment Practices	High Assessment Practices	-.47*	.07	.00	-.64	-.29

*. The mean difference is significant at the .05 level.

The comparison on Table 6 reveals p = .00 < .05 for teachers with low and moderate classroom assessment practices, p = .00 < .05 for teachers with low and high classroom assessment practices and p = .00 < .05 for teachers with high and moderate classroom assessment practices. Even though the difference between the mean of all possible pairs are statistically significant, the comparison is still essential because the Scheffe Test examines all possible pairwise comparisons and it is at this level (or analysis) that the direction of significance is known. This ensures that we do not overlook any potential effects between different levels of assessment practices. Therefore, the rejected null hypothesis is upheld. This means there is a significant difference in the impact of teachers' low, moderate and high classroom assessment practices on the mean attitude ratings of students in BS.

Table 7**.** ANOVA of Impact of Teachers Low, Moderate and High Classroom Assessment Practices on Critical Thinking Scores of Students

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1382.59	2	691.30	65.03	.00
Within Groups	4145.71	390	10.63		
Total	5528.30	392			

Table 7 reveals that $F(2,392) = 65.02$; p = .00 < .05. The null hypothesis is rejected. This means that there is a significant difference in the impact of teachers' of low, moderate and high classroom assessment practices on mean critical thinking scores of students in BS.

Table 8. Multiple Comparisons of Impact of Teachers' Low, Moderate and High Classroom Assessment Practices on Critical Thinking Scores of Students

Scheffe

(I) Low, Moderate, and High Classroom Assessment Practices	(J) Low, Moderate, and High Classroom Assessment Practices	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Low Assessment Practices	Moderate Assessment Practices	-.00	.43	1.00	-1.05	1.05
	High Assessment Practices	-4.31*	.49	.00	-5.51	-3.11
Moderate Assessment Practices	High Assessment Practices	-4.31*	.40	.00	-5.28	-3.33

*. The mean difference is significant at the .05 level.

Table 8 is the multiple comparisons of impact of teachers' low, moderate and high classroom assessment practices on critical thinking scores of students in Basic Science. The comparison reveals p = 1.000 > 0.05 for teachers' low and moderate classroom assessment practices, p = 0.000 < 0.05 for teachers' low and high classroom assessment practices and p = 0.000 < 0.05 for teachers' high and moderate classroom assessment practices. Even though the difference between the mean of teachers of low assessment and moderate assessment practices is not statistically significant, the comparison is still essential because the Scheffe Test examines all possible pairwise comparisons. This ensures that we do not overlook any potential effects between different levels of assessment practices. When the three effects are examined together, the rejected null hypothesis is upheld. This means that there is significant difference in the impact of teachers' low, moderate and high classroom assessment practices on mean critical thinking scores of students in Basic Science.

Table 9**.** t-Test of Difference in the Impact of Teachers Low, Moderate and High Classroom Assessment Practices on Male and Female Students' Attitude Ratings

Gender	N	Mean	SD	t	df	Sig	Remark
Male	43	2.69	.45				
Female	37	2.76	.20	.91	78	.36	NS
Male	118	2.80	.36				
Female	95	2.73	.40	1.16	211	.25	NS
Male	55	3.07	.62				
Female	45	3.35	.58	2.37	98	.02	S

Table 9 shows that t = 0.91 at df = 78; p = .36 > .05. The null hypothesis is not rejected. Thus, there is no significant difference in the impact of teachers' low classroom assessment practices on male and female students' mean attitude ratings in BS.

It can be seen in Table 9 that t = 1.16 at df = 211; p = .25 > .05. The null hypothesis is not rejected. This means that there is no significant differences in the impact of teachers of moderate classroom assessment practices on male and female students' mean attitude ratings in BS.

Table 9 equally displays that t = 2.37 at df = 98; p = .02 < .05. The null hypothesis is rejected. Therefore, there is significant difference in the impact of teachers high classroom assessment practices on male and female students' mean attitude ratings in BS.

Table 10. t-Test of Difference in the Impact of Teachers Low, Moderate and High Classroom Assessment Practices on Male and Female Students' Critical Thinking

Gender	N	Mean	SD	t	df	Sig	Remark
Male	43	2.98	4.25				
Female	37	3.11	2.21	.17	78	.87	NS
Male	118	2.91	2.74				
Female	95	3.18	3.06	.68	211	.50	NS
Male	55	7.43	3.66				
Female	45	7.11	3.74	.43	98	.67	NS

Table 10 reveals that t = .17 at df = 78; p = .87 > .05. The null hypothesis is not rejected. This means that there is no significant difference in the impact of teachers of low classroom assessment practices on male and female students' mean critical thinking scores in BS.

It can be seen in Table 10 that t = 0.68 at df = 211; p = .50 > .05. The null hypothesis is not rejected. This means that there is no significant difference in the impact of teachers of moderate classroom assessment practices on male and female students' mean critical thinking scores in BS.

Table 10 further displays that t = .43 at df = 98; p = .67 > .05. The null hypothesis is not rejected. This means that there is no significant difference in the impact of teachers of high classroom assessment practices on male and female students' mean critical thinking scores in BS.

DISCUSSION

It is shown that the difference in the impact of teachers' low, moderate and high classroom assessment practices on the mean attitude ratings of students in BS differs significantly. The multiple comparisons of the impact of teachers' low, moderate and high classroom assessment practices on attitude ratings of students in BS upheld the rejected null hypothesis. This means that there was a significant difference in the impact of teachers' low, moderate and high classroom assessment practices on the mean attitude ratings of students in BS. The finding is in agreement with Yusuf and Mahmut (2021) that formative assessment practices had a significant effect on students' attitudes towards mathematics. The finding concurs with Seyed, Rahul, Indrajit and Ehsan (2022) that the participants' attitudes towards prevailing assessment practices (summative and formative assessments) were positive.

Teachers' classroom assessment practices were found to reorder students' emotional well-being and create a supporting learning environment. This fosters a positive attitude towards BS. The students feel cared for and respected by their teachers and develop a sense of belonging and investment in science learning. Teachers' effective classroom assessment practices have positively influenced students' motivation and interest in BS. This is because students receive constructive feedback and see the connection between their efforts and their learning outcomes. Teachers' classroom assessment practices avail students chances to show their understanding and progress as they approach learning task with confidence and enthusiasm. These are meaningful ingredients of positive attitudinal disposition and may explain the significant difference found in the impact of teachers' low, moderate and high classroom assessment practices on the mean attitude ratings of students in BS.

Finding revealed that the difference in the impact of teachers of low, moderate and high classroom assessment practices on the mean critical thinking scores of students in BS was significant. The multiple comparisons of the impact of teachers' low, moderate and high classroom assessment practices on critical thinking scores of students in BS upheld the rejected null hypothesis. This implies that there was a significant difference in the impact of teachers' low, moderate and high classroom assessment practices on mean critical thinking scores of students in BS. There is agreement between this study and that of Achor and Ejeh (2019) that students with low cognitive ability level benefited more from the Cognitive Acceleration Training Programme (CATP). The finding is consistent with Karaman (2021) that increasing types of formative assessment practices in the classrooms both in quantity and frequency would promise a considerable contribution to student learning.

Teachers' classroom assessment practices involve constructive feedback that encourages critical thinking and enhances students' ability to analyze information and think critically. The teachers' classroom assessment practices used diverse assessment methods such as problem-solving task or project based assessment that foster critical thinking skills more effectively. Teachers' classroom assessment practices involved strategies for promoting deeper critical thinking skills through assessment. The teachers' classroom assessment practices was found to take into consideration the cultural context of Nigerian students in assessment practices thereby influencing critical thinking development and helping in tailoring assessment to students' backgrounds and experiences. This may provide plausible explanations for the significant difference found in the impact of teachers' low, moderate and high classroom assessment practices on mean critical thinking scores of students in BS.

The finding revealed no significant difference in the impact of teachers of low classroom assessment practices on male and female students' mean attitude ratings in BS. This signifies that there was no significant difference in the impact of teachers' low classroom assessment practices on male and female students' mean attitude ratings in BS. Similarly, the differences in the impact of teachers of moderate classroom assessment practices on male and female students' mean attitude ratings in BS was not significant. This denotes that there was no significant difference in the impact of teachers' moderate classroom assessment practices on male and female students' mean attitude ratings in BS. However, finding revealed that the impact of teachers of high classroom assessment practices on male and female students' mean attitude ratings in BS was significant. This means that there was a significant difference in the impact of teachers' high classroom assessment practices on male and female students' mean attitude ratings in BS.

Gender stereotype exists concerning students' attitude in BS class when teachers practice classroom assessments. However, the present study found no significant difference in the impact of teachers' low and moderate classroom assessment practices on male and female students' mean attitude ratings in BS. This implies that teachers' low and moderate classroom assessment practices do not discriminate between genders with respect to their attitude toward BS. This probably implies that the way classroom assessments are designed and implemented was found not to the perception of both genders on the relevance of BS to their lives and future aspirations. Conversely, the present study found significant differences in the impact of teachers' high classroom assessment practices on male and female students' mean attitude ratings in BS. This implies that teachers' high classroom assessment practices is gender sensitive with respect to students' attitude towards BS. This is because authentic assessment tasks mirror real-world scientific practices and help students see the value and applicability of Science concept beyond the classroom irrespective of gender.

Finding revealed that there was no significant difference in the impact of teachers of low classroom assessment practices on male and female students' mean critical thinking scores in BS. This implies that there was no significant difference in the impact of teachers' low classroom assessment practices on male and female students' mean critical thinking scores in BS. The finding agrees with Terhemba, Ayua and Ikyernum (2022) that the difference in the students' critical thinking level due to gender was not significant. The finding further revealed that there was no significant difference in the impact of teachers of moderate classroom assessment practices on male and female students' mean critical thinking scores in BS. This connotes that there was no significant difference in the impact of teachers' moderate classroom assessment practices on male and female students' mean critical thinking scores in Basic Science.

The finding further revealed that there was no significant difference in the impact of teachers of high classroom assessment practices on male and female students' mean critical thinking scores in BS. This indicates that there was no significant difference in the impact of teachers' high classroom assessment practices on male and female students' mean critical thinking scores in BS.

Gender stereotype exists concerning students' critical thinking in BS class when teachers practice classroom assessments. The present study found no significant difference in the impact of teachers' low, moderate as well as high classroom assessment practices on male and female students' mean critical thinking scores in BS. This implies that teachers' low, moderate as well as high classroom assessment practices have no gender influence concerning students' critical thinking in BS. This may have arisen because teachers' classroom assessment practices incorporate cultural background experiences, which allows students' critical engagement with learning materials and application of knowledge gained in meaningful ways irrespective of gender.

CONCLUSION

It is concluded that teachers' assessment practices in BS classes have great impact on students' attitude toward the subject and critical thinking in BS also. It was also concluded that teachers' assessment practices is not gender sensitive concerning students' attitude as well as critical thinking in BS. These have obvious implications for education. For instance, engaging learners regularly through constant employment of one form of assessment practice or another would enhance attitude and also critical thinking in basic science. Therefore it is implied that teachers need encouragement to constantly engage learners irrespective of gender as both males and females have positive disposition to improve their attitude and critical thinking in basic science when teachers engage them in relevant assessment practice.

The paper therefore recommends that:

1. To maximize the students' performance, Basic Science teachers should increase their frequency of assessment practices in order to encourage the development of positive attitude in their students.
2. Seminars, workshops and symposia as well as in-service training should be organized by the State Basic Education Commission for Basic Science teachers on the practices of various assessments in their teaching subjects to ensure gender equality in their assessment practices.
3. Basic Science teacher needs to be mindful of the assessment practices employed in the classroom so as to ensure proper acquisition of critical thinking skills.

ACKNOWLEDGMENT

The authors hereby acknowledge the principals, teachers, and students who participated in this study. We also acknowledge the Education Secretary in the Teaching Service Board of the state, who provided the introduction letter to be taken to schools for necessary attention. We remain grateful to you all.

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