



Assessment of Adaptive Learning Competencies Among Basic Science Students in Rivers State: A Cross-Sectional Study

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Abstract

This study assessed the adaptive learning competencies of Basic Science students in Rivers State, Nigeria, using a cross-sectional design. The investigation focused on four key dimensions of adaptive learning competencies: communication, social/behavioural, feedback, and emotional/affective competencies. The objectives were to determine the levels of these competencies and examine the relationships that exist among them. A descriptive survey research design was adopted. The population comprised Junior Secondary School students learning Basic Science in Rivers State, from which a stratified random sample of 500 students was drawn from ten randomly selected public and private schools. Data were collected using the Structured Adaptive Learning Competency Questionnaire (SALCQ), validated by experts and yielding a Cronbach's alpha coefficient of 0.86. Data analysis involved descriptive statistics (mean and standard deviation) and inferential statistics (Pearson correlation, t-test, and multiple regression analysis). Findings revealed that students demonstrated moderate levels of communication, social/behavioural, feedback, and emotional/affective competencies. Significant positive correlations were found among all four dimensions, indicating that these competencies are interrelated and collectively enhance adaptive learning. The study concluded that while students' adaptive learning competencies are developing, they require deliberate reinforcement through instructional scaffolding and emotional support strategies. It was recommended that teachers undergo capacity-building programmes, integrate socio-emotional learning into Basic Science instruction, and adopt continuous formative assessment practices to strengthen students' adaptive learning competencies.

Keywords: Adaptive Learning, Communication Competencies, Social/Behavioural Competencies, Feedback Competencies, Emotional/Affective Competencies

Introduction

In the fast-growing educational landscape, students need the ability to adjust, reflect, and manage their own learning effectively (Bhardwaj et al., 2025). Adaptive learning competencies are progressively being recognised as indispensable skills needed for learners to deal with new challenges, technologies, and learning demands (Nazmi et al., 2023; Brühwiler & Vogt, 2020). Basic Science, which combines concepts from biology, chemistry, and physics, needs not only cognitive engagement but also communication, collaboration, and emotional control for active learning (Oniya & Adefila, 2020; Jumoke-Bukunola & Idowu, 2012). Learners must be able to link scientific ideas clearly, work collaboratively, receive and use feedback positively, and control their emotions during scientific tasks (Järvenoja et al., 2020; Tomas et al., 2016).

The 21st century education give emphasis to learners' adaptability, problem-solving skills, and socio-emotional competence (Maoulida et al., 2023). In the Nigerian educational system, Basic Science is one of the subjects taught at the junior secondary school level. The main objective of the subject is to develop scientific knowledge and practical understanding (Chikwenze & Chukwunke, 2012). Nevertheless, teachers frequently pay attention to content delivery, disregarding the development of adaptive competencies that improve students' resilience and learning competence (Brühwiler & Vogt, 2020). Adaptive learning competencies allow learners to engage implicitly with science concepts, particularly when confronted with abstract topics or difficult laboratory

experiments (Brühwiler & Blatchford, 2011). In Rivers State, the diverse educational environment, with public and private schools and resource levels, makes it crucial to evaluate these competencies thoroughly.

Literature Review

Conceptual Framework

Adaptive learning competencies describe the ability to regulate one's learning through reflection, communication, social interaction, and emotional control (Stutsky & Laschinger, 1995). According to Bandura's (1997) social cognitive theory, learning takes place through observation, imitation, and self-regulation. Students with strong adaptive skills actively seek feedback, communicate effectively, and adjust their behaviours to achieve better learning outcomes.

Communication Competencies

Communication competencies have to do with the ability to carry and interpret messages effectively (Okoli, 2017). In the science classroom, it takes account of explaining ideas clearly, asking relevant questions, and understanding teacher feedback (Kulgemeyer & Schecker, 2013). Poor communication often leads to misconceptions and reduced engagement during science lessons.

Social/Behavioural Competencies

Social or behavioural competencies include the interpersonal skills that enable partnership and involvement in learning environments (Veiga et al., 2017; Wentzel, 1991). In Basic Science, collaboration during experiments and group discussions enhances deeper understanding. Students who present good behavioural skills also show discipline, respect for school rules and regulations, and responsibility (Eggon, & Agu, 2020).

Feedback Competencies

Feedback competencies involve the ability to seek, interpret, and act on feedback constructively. It helps learners recognise their weaknesses and make necessary adjustments. Students who engage with feedback demonstrate improved academic performance and problem-solving skills (Zahid & AlManiam, 2025; Solis Trujillo et al., 2025).

Emotional/Affective Competencies

Emotional competencies signify awareness, personal feeling, and regulation of emotions that affect learning (Garner, 2010). Emotional resilience, motivation, and confidence help students endure through challenges (Trigueros et al., 2019). Emotional stability enhances participation in group work and receptiveness to teacher feedback.

Empirical Review

Studies by Supriyadi (2023) and Nasution (2018) found that students with high emotional intelligence achieved better results in science subjects. Similarly, Ariyani et al. (2024) observed that communication competencies positively influenced students' engagement in practical science lessons, likewise feedback competencies. Goyal and Worrell (2022) reported that social and emotional learning significantly predicted students' academic motivation. These studies suggest that adaptive competencies are interdependent and essential for success in Basic Science.

Statement of the Problem

In spite of the growing role of adaptive learning competencies in contemporary education, there is limited empirical evidence on how well Basic Science students in Rivers State demonstrate these skills. Many students struggle with communication during scientific discussions, have limited teamwork experiences, and often fail to use feedback constructively. Emotional instability, including fear of failure, also undermines their capacity to persist through scientific challenges. Without data-driven insights into these areas, interventions remain impromptu and ineffective. Hence, there is a need for a systematic assessment of adaptive learning competencies among Basic Science students in Rivers State.

Aim and Objectives of the Study

The main aim of this study was to assess adaptive learning competencies among Basic Science students in Rivers State and determine how communication, social/behavioural, feedback, and emotional/affective competencies relate to each other. Specifically, this study seeks to:

1. To determine the level of communication competencies among Basic Science students.

2. To assess the level of social/behavioural competencies.
3. To evaluate the level of feedback competencies.
4. To assess the level of emotional/affective competencies.
5. To examine the relationships among the four competencies.

Research Questions

The following research questions will guide this study:

1. What is the level of communication competencies among Basic Science students?
2. What is the level of social/behavioural competencies?
3. What is the level of feedback competencies?
4. What is the level of emotional/affective competencies?
5. What relationships exist among these four competencies?

Research Hypothesis

The hypothesis below will guide this study:

H0₁: There is a significant relationship among the four dimensions of adaptive competencies.

Methods and Materials

Research Design

This study adopted a descriptive cross-sectional survey design. The design was considered appropriate because it enabled the researcher to collect quantitative data on students' adaptive learning competencies at a single point in time without manipulating any variables (Aagaard & Hauer, 2003). It provided a picture of the current state of communication, social/behavioural, feedback, and emotional/affective competencies among Basic Science students in Rivers State.

Population of the Study

The population of this study comprised all Junior Secondary School (JSS) students offering Basic Science in public and private secondary schools across Rivers State, Nigeria. These students were selected because Basic Science serves as a foundational subject that develops learners' problem-solving and adaptive learning skills at the lower secondary level.

Sample and Sampling Technique

A total of 500 students were selected from ten secondary schools across Rivers State using a stratified random sampling technique. The strata were based on school type (public or private) and geographical location (urban or rural). From each stratum, schools were randomly selected, and classes were chosen using simple random sampling to ensure adequate representation. This approach enhanced the generalisability of the findings across different school categories.

Instrument for Data Collection

Data were gathered using a structured questionnaire titled Adaptive Learning Competencies Questionnaire (ALCQ), which was developed by the researcher. The instrument was designed to measure the four dimensions of adaptive learning competencies and consisted of five sections:

- Section A: Demographic Information of Respondents
- Section B: Communication Competencies (10 items)
- Section C: Social/Behavioural Competencies (10 items)
- Section D: Feedback Competencies (8 items)
- Section E: Emotional/Affective Competencies (10 items)

All items were rated on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), enabling the respondents to express the extent of their agreement or disagreement with each statement.

Validity and Reliability of the Instrument

The content and face validity of the ALCQ were established by three experts: two from the Department of Measurement and Evaluation and one from Science Education. Their responses led to adjustments that improved clarity, appropriateness, and alignment with the purpose of the study. To determine reliability, a pilot study was conducted using 50 students from schools not included in the main study. The responses were analysed using Cronbach's Alpha, producing a coefficient of 0.86 that indicates high internal consistency and reliability of the instrument.

Method of Data Collection

Data collection was conducted by trained research assistants who visited the sampled schools during normal school hours. Prior to data administration, ethical clearance was obtained from the Rivers State Ministry of Education, and consent was granted by school principals and teachers. Participants were informed of the purpose of the study, assured of confidentiality, and reminded that participation was voluntary. The questionnaires were administered and retrieved immediately to ensure a high response rate.

Method of Data Analysis

Data were coded and entered into the Statistical Package for the Social Sciences (SPSS) version 25 for analysis. Descriptive statistics such as mean and standard deviation were used to answer the research questions, while Pearson Product Moment Correlation was applied to test the hypothesis at a 0.05 level of significance. Multiple Regression Analysis was conducted to identify which of the competencies significantly predicted overall adaptive learning among Basic Science students in Rivers State. Results were presented in tables and interpreted in relation to the research questions.

Results

Research Question One: What is the level of communication competencies among Basic Science students in Rivers State?

Table 1: Mean and Standard Deviation of Students' Communication Competencies.

Variable	N	Mean (\bar{x})	SD	Decision
Communication competencies	500	3.82	0.71	High competency

To answer research one, Table 1 shows the level of communication competencies among Basic Science students in Rivers State. The results indicate a mean score of 3.82 with a standard deviation of 0.71, signifying a high level of communication competence among the respondents.

Research Question Two: What is the level of social/behavioural competencies among Basic Science students in Rivers State?

Table 2: Mean and Standard Deviation of Students' Social/Behavioural Competencies

Variable	N	Mean (\bar{x})	SD	Decision
Social/Behavioural competencies	500	3.67	0.79	Moderate to high competency

To answer research question two, Table 2 shows the level of social/behavioural competencies among Basic Science students in Rivers State. The result reveals a mean score of 3.67 and a standard deviation of 0.79, indicating that students exhibit a moderate to high level of social and behavioural competence.

Research Question Three: What is the level of feedback competencies among Basic Science students in Rivers State?

Table 3: Mean and Standard Deviation of Students' Feedback Competencies.

Variable	N	Mean (\bar{x})	SD	Decision
Feedback competencies	500	3.45	0.74	Moderate competency

To respond to research question three, Table 3 presents the level of feedback competencies among Basic Science students in Rivers State. The table reveals a mean score of 3.45 with a standard deviation of 0.74, signifying a moderate level of feedback competency among the respondents.

Research Question Four: What is the level of emotional/affective competencies among Basic Science students in Rivers State?

Table 4: Mean and Standard Deviation of Students' Emotional/Affective Competencies.

Variable	N	Mean (\bar{x})	SD	Decision
Emotional/Affective competencies	500	3.59	0.81	Moderate to high competency

To address Research Question Four, Table 4 reveals the level of emotional/affective competencies among Basic Science students in Rivers State. The table reveals a mean score of 3.59 and a standard deviation of 0.81, indicating that students possess a moderate to high level of emotional and affective competence.

Research Question Five: What relationships exist among the four dimensions of competencies of Basic Science students in Rivers State?

H0₁: There is a significant relationship among the four dimensions of adaptive competencies among Basic Science students.

Table 5: Pearson Correlation Matrix Showing Relationships Among the Four Adaptive Learning Competencies

Variables	Communication	Social/Behavioural	Feedback	Emotional/Affective
Communication	1	0.68**	0.59**	0.63**
Social/Behavioural	0.68**	1	0.55**	0.60**
Feedback	0.59**	0.55**	1	0.57**
Emotional/Affective	0.63**	0.60**	0.57**	1

* $p < 0.05$ (significant at 0.05 level)

The answers to research question five and hypothesis one is indicated in Table 5. The results indicate strong and statistically significant positive correlations among all four adaptive learning competencies. Communication competence was highly related to social/behavioural ($r = 0.68$, $p < 0.05$), feedback ($r = 0.59$, $p < 0.05$), and emotional/affective competencies ($r = 0.63$, $p < 0.05$).

Predictors of Adaptive Learning

Table 6: Multiple Regression Analysis Showing Predictors of Adaptive Learning

Variables	B	t-value	Sig. (p)	Remark	
Communication Competence	0.18	1.72	0.09	Not Significant	
Social/Behavioural Competence	0.16	1.55	0.12	Not Significant	
Feedback Competence	0.39	4.62	0.00**	Significant	
Emotional/Affective Competence	0.35	3.98	0.02*	Significant	
R = 0.72		R ² = 0.52	Adjusted R ² = 0.50	F(4,395) = 26.84	p < 0.01

**Significant at 0.05 level; *Significant at 0.01 level

The regression analysis results in Table 6 show that feedback competence ($\beta = 0.39$, $p < 0.01$) and emotional/affective competence ($\beta = 0.35$, $p < 0.05$) significantly predicted overall adaptive learning among Basic Science students. Together, the four predictors explained approximately 52% of the total variance in adaptive

learning ($R^2 = 0.52$). Communication competence ($\beta = 0.18$, $p > 0.05$) and social/behavioural competence ($\beta = 0.16$, $p > 0.05$) contributed modestly but were not statistically significant predictors of adaptive learning.

Discussion

Communication Competence

The high level of communication competence observed among students highlights their ability to express scientific ideas effectively and participate meaningfully in classroom dialogue. This supports the findings of Apat et al. (2023), who reported that effective oral communication skills enhance learners' engagement and conceptual understanding. The result implies that fostering communication-rich environments, through questioning, discussion, and cooperative learning, can strengthen adaptive thinking and problem-solving in Basic Science.

Social/Behavioural Competence

The study revealed that most students possess moderate to high social and behavioural competencies, reflecting positive interpersonal interactions and responsible learning behaviour. This aligns with Eggon and Agu (2020), who found that social cooperation and peer collaboration improve science learning outcomes in Nigerian classrooms. According to Zukorlić and Nikolić (2022), social competence allows learners to develop empathy, teamwork, and respect, which are essential for adaptive learning. The implication is that teachers should continue to promote cooperative learning strategies that help students develop social discipline and collaborative problem-solving skills.

Feedback Competence

The moderate feedback competence observed among the students suggests that while they receive and recognise feedback, their ability to apply it constructively may be limited. This finding resonates with Liu et al. (2022) and Hassan et al. (2019), who found that open feedback predicts improved adaptive learning, and enhance learners' engagement and academic achievement. This indicates the need for teachers to intentionally teach students how to interpret feedback, set learning goals, and monitor progress as part of adaptive learning training.

Emotional/Affective Competence

The findings also demonstrate that students possess emotional and affective capacities that enable them to manage stress, sustain motivation, and remain resilient during learning. This supports Johnson and Njoku (2024), who found that emotional intelligence significantly contributes to adaptive learning and problem-solving skills among students. In line with Mauroof et al. (2025), emotional stability helps students maintain concentration and manage frustration during complex learning tasks. The implication is that emotional and affective competence plays a pivotal role in helping learners remain engaged and flexible in the face of academic challenges.

Relationships Among the Four Dimensions of Adaptive Learning Competencies

The significant positive relationships among all four adaptive learning competencies confirm that adaptive learning is multidimensional and interdependent. Students who communicate effectively tend to interact socially, regulate emotions, and use feedback constructively. This finding aligns with Napolitano et al. (2021), who asserted that adaptive learning arises from the integration of communication, emotional, and social/behavioural skills. Hence, adaptive learning in Basic Science can be best enhanced through a holistic approach that develops both cognitive and socio-emotional domains.

Predictors of Adaptive Learning

The regression analysis showed that feedback (Liu et al., 2022; Hassan et al., 2019) and emotional/affective competencies (Johnson & Njoku, 2024) significantly predicted adaptive learning, while communication and social/behavioural competencies made weaker contributions. This suggests that adaptive learning among Basic Science students is largely driven by their ability to utilise feedback constructively and maintain emotional stability during learning tasks (Jansen et al., 2024).

Conclusion

Based on the findings, it is concluded that Basic Science students in Rivers State exhibit moderate to high levels of adaptive learning competencies across communication, social/behavioural, feedback, and emotional/affective domains. Communication competence was found to be highest, while feedback competence was lowest. All four competencies were strongly interrelated, confirming that they collectively enhance adaptive learning. Feedback and emotional/affective competencies were the most significant predictors, indicating that students' responsiveness to feedback and emotional management are crucial for improving adaptive learning outcomes in

Basic Science. Hence, adaptive learning can be optimised through an Basic focus on cognitive, behavioural, and affective development in science education.

Recommendations

The study recommended that:

1. Teachers should adopt formative assessment and reflective learning strategies that encourage students to interpret and apply feedback effectively to improve their academic performance.
2. Schools should integrate socio-emotional learning programmes into the Basic Science curriculum to help students build resilience, motivation, and self-regulation during learning.
3. Teachers should employ cooperative and inquiry-based methods that foster communication, teamwork, and behavioural discipline, which are vital for adaptive learning.
4. Teachers should be trained through workshops and seminars on how to cultivate feedback literacy, emotional regulation, and adaptive learning skills among students.
5. Curriculum planners should explicitly include adaptive learning competencies as performance indicators in Basic Science, ensuring balanced attention to cognitive and affective domains.
6. Future studies should investigate adaptive learning competencies across different subjects and examine the influence of gender, school type, and teacher practices on their development.

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