

## **PREDICTING BIOLOGY ACADEMIC ACHIEVEMENT OF STUDENTS USING SCORES FROM EMOTIONAL INTELLIGENCE IN ENUGU EDUCATION ZONE**

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DOI: <https://doi.org/10.5281/zenodo.10682939>

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**Abstract:** This study focused on Predicting Biology Academic Achievement of Students using Scores from Emotional Intelligence in Enugu Education Zone, Enugu State, Nigeria. The main purpose was to find the relationship between emotional intelligence and students' achievement in Biology. Two research questions and three hypotheses were formulated to guide the study. The study adopted a correlational design. The population for the study was 4825 (2813 male and 2012 female) SS2 students from 31 government secondary schools in Enugu Education zone. The sample for the study was 483 SS2 Biology students comprising of 282 males and 201 females from six senior secondary schools in the study area. Simple random sampling technique was used for selection of the schools for the study. Youth version of emotional quotient inventory (EQ-i2.0) and a Biology Achievement Test (BAT) were used for data collection. Data were subjected to descriptive and inferential statistical analysis using multiple linear regression to answer the research questions, and null hypotheses was tested at 0.05 level of significance. The results revealed that there was a significant positive correlation between emotional intelligence and students' achievement in Biology. A significant positive relationship also exists between each predictor variable and students' achievement in Biology. It was concluded that emotional intelligence influences students' achievement in Biology, and female students achieved relatively better than male students. Based on the findings of this study, it was recommended that government should organize workshops and seminars for in-service teachers and teacher trainees to enable them understand the concept of emotional intelligence in order to develop their own emotional intelligence and that of their students. Also, planning and teaching of Biology should encourage gender equality and encourage the use of techniques that cater for the emotional needs of both males and females alike.

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**Keywords:** Emotional Intelligence, achievement, biology, self-perception, self-expression, interpersonal skills, stress management and decision making

### **Introduction:**

In the contemporary educational landscape, the pursuit of academic excellence among students has been an enduring objective for educational stakeholders worldwide. Within the realm of science education, particularly in

the field of Biology, achieving proficiency holds significant importance given its foundational role in understanding living organisms and their interactions with the environment. However, despite the acknowledged importance of Biology in everyday life and its applications in various sectors such as medicine, agriculture, and environmental conservation (Wikipedia, 2021), there exists a concerning trend of subpar academic performance among students in this subject.

Over the years, numerous studies have documented the persistent challenge of poor academic achievement in Biology among secondary school students, particularly within the Nigerian education system (Nworgu, 2016; Sa'ad & Usman, 2016). Statistical data from examination bodies such as the National Examination Council (NECO) and the West Africa Examination Council (WAEC) reveal fluctuating pass rates, with instances of significant underperformance recorded in both national and regional examinations (NECO result statistics, 2021). This ongoing issue not only reflects a pedagogical failure but also underscores broader systemic challenges within the educational framework.

Various factors have been attributed to the observed decline in academic performance in Biology. While some studies have focused on institutional factors such as government policies, teacher quality, and infrastructure (Agrawal & Teotia, 2015; Ekeh, 2013; Ezeudu & Obi, 2013), others have explored student-related variables, albeit to a lesser extent (Zakariya & Bamidele, 2015). Notably, there has been a growing recognition of the role of emotional intelligence (EI) in shaping academic outcomes, including in the domain of science education (Perera, 2015; Goleman & Senge, 2014).

Emotional intelligence, as conceptualized by Multi-Health Systems (2018), encompasses the ability to recognize, understand, and manage one's own emotions as well as those of others. It comprises several dimensions, including self-perception, self-expression, interpersonal skills, stress management, and decision-making (Bar-On, 2016). Research suggests that individuals with higher levels of emotional intelligence exhibit greater resilience, adaptability, and problem-solving abilities, which are essential for navigating academic challenges effectively (Haney-Caron, 2014; Tanglang & Ibrahim, 2015).

Moreover, the role of stress management, a component of emotional intelligence, cannot be overstated in the context of academic achievement. Stress, though inevitable, can significantly impact students' cognitive functioning and overall well-being, potentially hindering their academic performance (Azila-Gbettor et al., 2015; Owoyele, 2019). Effective stress management techniques, such as flexibility, stress tolerance, and optimism, have been shown to mitigate the adverse effects of stress and foster academic success (Veena & Shastri, 2016; Owoyele, 2016).

Furthermore, the emotional development of students emerges as a critical determinant of academic performance and socio-emotional well-being. Scholars have underscored the importance of emotional awareness, social interaction, and decision-making skills in fostering positive academic outcomes and preventing maladaptive behaviors (Nworgu, 2016; Elias & Weissberg, 2014). Particularly within the Nigerian educational context, where demands for emotional intelligence skills are increasingly recognized (Oyinloye, 2015), investigating the relationship between emotional intelligence and Biology academic achievement holds significant relevance. In light of the foregoing, this study seeks to address a notable gap in the existing literature by examining the predicting biology academic achievement of students using scores from emotional intelligence in Enugu Education Zone

### Statement of Problem

The inconsistency in academic excellence for science inclined students in Enugu Educational Zone has been a major source of concern to stakeholders and policy makers in the Enugu education sector. Despite all the strategies used by teachers to educate students so as to increase academic achievements among students, its effect does not fully enhance students' performance, most especially in science related subjects, Biology inclusive. Targeting solely at teacher and infrastructural improvement without watching out for measures to improve effective learning appears to be an error of pedagogy, as most blames for poor performance of students falls on either the teacher or poor infrastructure for proper learning.

Education in Nigeria seldom accords regards to the emotional needs of the learners though emotional intelligence has been thought to be an important variable capable of improving learners' kinetics and enhancing students' achievement. Many educationists, teachers and students in Nigeria have little or no idea of emotional intelligence and how it relates to achievement. Hence, there is need to strengthen more research to clarify contending issues for criticizing the authenticity and validity of the enhancement of academic achievement. This is the bridge or gap this study is anchored on; i.e., to find out ways to predict academic achievement of students in biology using their emotional intelligence as an index.

### Purpose of the Study

The purpose of the study was to predict Biology academic achievement of students using scores from their emotional intelligence. Specifically, the study determined the:

- i. Amount of variation in the students' achievement in Biology that can be attributed to each dimension of emotional intelligence (self-perception, self-expression, interpersonal skills, stress management and decision making).
- ii. Amount of variation in the students' achievement in Biology that can be accounted for by all the dimensions of students' emotional intelligence (self-perception, self-expression, interpersonal skills, stress management and decision making, altogether).

### Research Questions

The following research questions were posed to guide the study.

1. What is the amount of variation in the students' achievement in Biology that can be attributed to each dimension of emotional intelligence?
2. What is the amount of variation in the students' achievement in Biology that can be accounted for by all the dimensions of students' emotional intelligence?

### Hypotheses

The following null hypotheses were formulated to guide the study. They were tested at 0.05 level of significance.

**H<sub>01</sub>:** The regression coefficient associated with the predictor variables (students' self-perception, self-expression, interpersonal skills, decision making and stress management) in predicting students' achievement in Biology is not significant.

**H<sub>02</sub>:** Students' achievement in Biology by emotional intelligence is not significantly predicted by Gender.

**H<sub>03</sub>:** The regression model for predicting students' achievement in Biology by their emotional intelligence is not significant.

## LITERATURE REVIEW

The review of literature for this study was organized under the following sub-themes: conceptual framework, theoretical framework, empirical studies and summary of review of literature.

### Conceptual Framework

#### Concept of Emotional Intelligence

Emotions have long been viewed as diametrically opposed to rationality, with classical Greek philosophers advocating for the supremacy of rational intellectual reasoning over emotional impulses (Alavinia & Mollahosseini, 2012). However, contemporary understanding recognizes the integral role of emotions in human cognition and behavior. Emotional intelligence (EI) represents a paradigm shift, acknowledging emotions as valuable sources of information that can guide decision-making and problem-solving (Matthews, Roberts & Zeidner, 2014). Contrary to traditional notions, EI encompasses the ability to perceive, understand, and manage one's own emotions as well as those of others, emphasizing the symbiotic relationship between emotion and cognition (Mayer et al., 2012).

Historically, intelligence has been predominantly associated with cognitive abilities such as reasoning and problem-solving. However, the emergence of EI challenges this narrow conception by recognizing the importance of social and emotional competencies in adaptive functioning (Beytekin, 2013). Gardner's theory of multiple intelligences expanded the notion of intelligence to include interpersonal and intrapersonal capacities, laying the groundwork for the development of EI as a distinct construct (Goleman, 2016). Consequently, research on EI has gained momentum, driven by its potential to enhance interpersonal relationships, mental health, and academic performance (Nourizade & Mohseni, 2014).

The evolution of the concept of emotional intelligence can be delineated into five distinct periods, reflecting shifts in theoretical frameworks and research methodologies (Rohr, 2015). From the initial recognition of emotion as an adaptive mechanism to the institutionalization of EI as a valid construct, scholars have traversed a trajectory marked by conceptual refinement and empirical validation (Pérez, Petrides & Furnham, 2005). Despite ongoing debates and conceptual ambiguities, EI continues to garner attention as a key determinant of success in various domains, underscoring its relevance in both theory and practice (Bar-On, 2017). As researchers delve deeper into the complexities of human emotion and cognition, the concept of emotional intelligence promises to illuminate new pathways for understanding human behavior and promoting personal well-being.

#### Evolution of Emotional Intelligence

The evolution of emotional intelligence (EI) spans over a century, characterized by successive stages of conceptual development and empirical exploration (Mayer et al., 2012). Initially perceived as distinct and separate from cognitive abilities, emotions gradually gained recognition as integral components of human intelligence (Gayathri & Meenashi, 2013). Gardner's theory of multiple intelligences provided a seminal framework for understanding the diverse facets of intelligence, laying the groundwork for the conceptualization of EI as a distinct form of intelligence (Beytekin, 2013).

During the emergence of EI in the 1990s, Mayer and Salovey proposed a groundbreaking model that conceptualized emotional intelligence as a multifaceted construct encompassing perception, understanding, and regulation of emotions (Nourizade & Mohseni, 2014). Subsequent research by Goleman popularized the concept of EI, sparking widespread interest and debate within both academic and popular discourse (Rohr, 2015). Despite

criticisms and controversies surrounding its measurement and application, EI gained traction as a valuable predictor of personal and professional success (Gibbs, 1995).

The popularization and institutionalization of EI in the late 20th century marked a significant milestone in its evolutionary trajectory (Bar-On, 2017). With the publication of seminal works and the development of standardized measures, EI transitioned from a theoretical concept to a practical tool for personal development and organizational enhancement (Vierimaa, 2013). Today, research on EI continues to advance, driven by the recognition of its relevance in diverse contexts ranging from education to workplace performance (Parker, Taylor, & Bagby, 2011). As scholars navigate the complexities of emotion and cognition, the evolution of EI promises to illuminate new avenues for understanding human behavior and fostering emotional well-being.

### **Contemporary Understanding of Emotional Intelligence**

Emotional intelligence (EI) represents a paradigm shift in the conceptualization of human intelligence, acknowledging the central role of emotions in cognition and behavior (Matthews, Roberts & Zeidner, 2014). Contrary to traditional views that privilege cognitive abilities, EI recognizes the importance of social and emotional competencies in adaptive functioning (Beytekin, 2013). Mayer and Salovey's model of EI, which emphasizes the perception, understanding, and regulation of emotions, provided a foundational framework for subsequent research and application (Gayathri & Meenashi, 2013).

The contemporary understanding of EI extends beyond individual capacities to encompass interpersonal dynamics and environmental influences (Nourizade & Mohseni, 2014). Reuven Bar-On's conceptualization of emotional quotient (EQ) highlights the interactive nature of EI, emphasizing the importance of self-awareness, social relationships, and coping mechanisms in navigating life's challenges (Vierimaa, 2013). As such, EI is increasingly recognized as a critical determinant of success in various domains, including education, health, and leadership (Bar-On, 2017).

In practice, the concept of emotional intelligence informs interventions aimed at enhancing emotional well-being and interpersonal effectiveness (Parker, Taylor, & Bagby, 2011). By fostering self-awareness, empathy, and resilience, individuals can develop the skills necessary to thrive in diverse social and organizational contexts (Hayward, 2015). Moreover, the integration of EI into educational curricula and workplace training programs reflects a growing recognition of its practical utility in promoting personal and professional growth (Goleman, 2016). As research on EI continues to evolve, its impact on individual development and societal outcomes remains a subject of ongoing inquiry and exploration.

### **Academic Achievement in Biology**

Education serves as a cornerstone for economic growth and development, with science and technology playing pivotal roles in distinguishing nations on the global stage (Agi & Yellowe, 2013; Mefor, 2014). Within the Nigerian context, the Minister of Education emphasized the crucial role of Biology in driving progress, highlighting the imperative to address the persistent issue of poor academic performance in the subject (Rufa'i, 2012). Despite fluctuations in academic results over the years, challenges persist, as evidenced by widespread failures in external examinations such as the West Africa Examination Council (WAEC) (Sa'ad & Usman, 2016). This trend not only hampers individual educational attainment but also undermines the country's scientific and technological advancement (Ojimba, 2012).

Various factors contribute to the prevalent poor performance in Biology among secondary school students, ranging from pedagogical shortcomings to systemic inadequacies (Nworgu, 2016; Sa'ad, Adamu & Sadiq, 2014).

While much attention has been directed towards government policies and educational infrastructure, the role of learners themselves has often been overlooked (Zakariya & Bamidele, 2015). Learners are frequently portrayed as passive recipients of knowledge, lacking agency and emotional competencies crucial for effective learning (Dardello, 2017). However, research suggests that cognitive abilities alone are insufficient predictors of academic success, underscoring the importance of emotional intelligence in facilitating learning and achievement (McKee, 2016; Goleman & Senge, 2014). Consequently, addressing affective constructs such as emotional regulation may hold the key to mitigating the persistent challenge of poor academic performance in Biology (Perera, 2015).

### **Gender and Academic Achievement**

Gender differences play a significant role in shaping educational outcomes, with societal expectations and biological factors influencing students' performance and attitudes towards learning (Shettima, 2016). Across cultures, males and females are socialized differently, resulting in distinct behavioral patterns and cognitive processes (Umoh, 2013). While males are often characterized as bold and competitive, females are perceived as nurturing and cooperative (Ezeudu & Obi, 2013). These gendered attributes extend to emotional expression and processing, with females generally exhibiting higher levels of empathy and interpersonal sensitivity (Drago, 2014; Svetlana, 2017).

Neuroimaging studies suggest that gender differences in cognitive functions may be linked to variations in brain structure, with females demonstrating enhanced emotional processing abilities (Adigwe, 2015). Moreover, childhood experiences and socialization practices contribute to the development of emotional intelligence, with females typically displaying greater emotional awareness and expression from an early age (Harrod & Scheer, 2015). While females tend to excel in empathy and interpersonal skills, males may exhibit strengths in emotional regulation and adaptability (Bindu & Thomas, 2016; Tsai & Liu, 2015).

Despite ongoing debates regarding gender differences in emotional intelligence, studies indicate nuanced variations in specific facets of emotional competence between males and females (Bar-On, 2016; Shutte, Malouff & Thorsteinsson, 2013). While overall emotional intelligence may not differ significantly between genders, distinct patterns emerge in interpersonal dynamics and self-awareness (Palmera et al., 2013). However, the impact of gender on academic achievement in Biology remains inconclusive, highlighting the need for further exploration of gender-related factors in educational outcomes (Nasir & Masrur, 2015). In this study, gender serves as a moderating variable in examining the relationship between emotional intelligence and students' performance in Biology, aiming to elucidate the complex interplay between gender, emotions, and academic success.

### **Theoretical Review**

#### **Theory of Emotional Consciousness by LeDoux**

Emotional memories give the emotional quality to concrete memories because the brain fuses the two so it seems like they are coming from the same place. LeDoux (2014) propounded a theory of emotion that calls to mind the salient need for intelligence in the engagement of emotion (often referred to as primitive and disruptive mind), in order to allow the learner, recognize and manage emotions to avoid its disruptive tendencies. The theory also leads an explanation to such disorders as phobias, fears, panic attacks and post-traumatic stress disorder students experience in Biology. LeDoux showed that the thalamus is the major integrating center of the brain where all sensory impulses and information from internal and external environments are received and relayed to other parts of the brain. The amygdala, part of the limbic system, is key in the production of emotional states which receives impulses from the thalamus via two routes: auditory thalamus and auditory cortex. Sensations that produce the

primary emotions may travel to this unit bypassing any cognitive apparatus, to produce an immediate reaction that is key to survival. Other inputs first travel through the cortex (the center for thought, and storage of facts and concrete memories), where they are cognitively evaluated prior to moving on to the limbic system and amygdala to be processed as secondary emotions.

Emotional data is designed to provide more important information to the cognitive brain for assessing situations and making valued judgment, however, if this information are negatively interpreted during Biology lesson, fear, tension, panic and phobia creates a resultant effect which translates to poor academic achievement in Biology and a consequent poor performance in Biology. Deductions from the theory explains that sensory inputs are translated by the cognitive brain during Biology lessons and forged into a representation with meaning that first passes through the emotional brain where it is rapidly evaluated. Neural schemata if not intelligently handled tend to become rigid patterns of information processing, shaping subsequent patterns and making sense of the content of Biology lessons. Emotional stimulation inevitably necessary for activating certain schematic thought patterns, if not intelligently handled, may lead to frustration. This fusion of emotion and cognition in an intelligent manner to achieve ones' target is the hallmark of emotional intelligence. It requires emotional sensitivity, the ability to evaluate emotions within a variety of social circumstances to succeed in life, since emotions influence how people think, make decisions, and perform different tasks. Biology requires a high level of concentration, emotional stability and intelligence so that the fusion of both emotion and cognition result in maximum achievement in Biology. Therefore, based on the assertion of LeDoux (1994), the present study seeks to assess emotional intelligence and its relationship with student's achievement in Biology. The implication of LeDoux's theory on the present study would be the ability of teachers to understand the effect of disorders such as phobias, fears, panic attacks and post-traumatic stress disorder in students hence giving the teacher an edge in knowing the best way to guide the students towards positive academic achievement in Biology.

### **Empirical Studies**

Studies conducted by Seng, Hanafi, Taslikhan and Raman (2016) showed the influence of emotional intelligence on students' academic achievement. The purpose of the study was to determine the influence of emotional intelligence on students' achievement. The design of the study was correlational design. Five hypotheses guided the study. Samples of 406 students from nine schools in Limbang District, Sarawak were involved in the study. Malaysia Intelligence Emotional Inventory – Teens (IKEM-R), consisting of 49 items with all Cronbach alpha values exceeding 0.900 was used to assess the level of students' emotional intelligence. Dimensions of emotional intelligence investigated include Self-awareness, Self-regulation, Self-Motivation, Empathy and Social skills. Exploratory factor analysis and KMO value for pilot study was 0.607. The result of the study show that all the emotional intelligence dimensions are at high level. The data collected was analyzed using SPSS version 20 to measure reliability value per item, and emotional intelligence dimensions. Exploratory factor analysis was used to test reliability (factor loadings) and validity (KMO). Further, the results revealed that there is no significant influence of all the dimensions of emotional intelligence on academic achievement. All the emotional intelligence dimensions namely emotional awareness, emotional regulation, self-motivation, empathy and social skills do not affect students' academic achievement. However, the study design was not mentioned. The study was conducted in Limberg district, Sarawak Malaysia and investigated Self-awareness, Self- regulation, Self-Motivation, Empathy and Social skills as dimensions of emotional intelligence. No clear subject on which academic achievement was measured was mentioned in the study. The current study shall however assess emotional

intelligence as self-perception, self-expression, interpersonal skills, stress management and decision making and its relationship with students' achievement in Biology adopting a correlation design. The current study was conducted in Enugu education zone, Enugu state, Nigeria.

Studies carried out by Durgut, Gerekan and Pehlivan (2013) showed the impact of emotional intelligence on the achievement of accounting subject. The purpose of the study was to determine the importance of emotional intelligence on accounting education. Two research questions guided the study. The sample was 177 students who are attending accounting lessons in two different state universities in Turkey were involved in the study. The instrument for the study was Emotional Quotient Inventory developed by Bar-On (1997). Survey method was used as data collection technique, and analysis was done by SPSS version 16. Correlation and regression analyses were performed for data analysis. It was found that Independency, self- fulfillment, social responsibility, flexibility and problem solving which are the components of emotional intelligence had an impact on the achievement of accounting subject. Therefore, they concluded that some sub-components of the emotional intelligence are influential on accounting achievement. The study was anchored on achievement in accounting students in Turkey but the present study accessed emotional intelligence of SS II students and determined its relationship with achievement in Biology, in Enugu education zone, Enugu State, Nigeria.

Research conducted by Qualter, Gardner, Pope, Hutchinson and Whiteley (2012) investigated the long-term effects of ability and trait EI on academic performance of British adolescents. The purpose of the study was to determine the effect of ability EI and trait EI on academic performance of adolescent students. Two hypotheses guided the study. The sample comprised 413 students from three secondary schools in the North-West of England. Students completed tests of ability EI, trait EI, personality, and cognitive ability in Year 7 (mean age = 11 years 2 months). Performance data at the end of Year 11 (mean age = 15 years 10 months) were collected. Trait EI was accessed using the Bar-On EQ-i:Yv consisting of 60 items with four main subscales: interpersonal, intrapersonal, stress management, and adaptability. For this sample, internal consistency scores for the subscales were reasonable for girls and boys respectively:  $\alpha = 0.64$  and  $0.62$  (intrapersonal),  $0.82$  and  $0.75$  (stress management),  $0.79$  and  $0.74$  (adaptability) and  $0.82$  and  $0.78$  (interpersonal). Ability EI was measured using the MSCEIT-Yv (youth version) designed for pre-adolescents and adolescents consisting of 101 items (of which 97 are scored) to measures how well children perform tasks and solve emotional problems. Multi-Health Systems, the test distributor, using expert norms, scored the data. Internal consistency scores of the MSCEIT-Yv are provided in the manual for the four branches, with split half reliabilities ranging from  $\alpha = 0.67$  (Section A: Perceiving emotion) to  $0.86$  (Section C: Understanding emotions); the overall measure  $\alpha = 0.91$ . Internal consistency scores are currently not available from the test publisher for male and females separately. Structural Equation Modelling was used to examine the longitudinal relationships between latent variables of these constructs. Results show that the importance of ability EI resides in the fact that it moderates the effect of cognitive ability on performance in Year 11. Trait EI has a direct effect on Year 11 performance for boys only. The study investigated long term effect of two conceptions of emotional intelligence on academic achievement of students.

Review from the study conducted by Nwadinigwe and Azuka-Obieke (2012) showed the impact of emotional intelligence on academic achievement of senior secondary school students in Lagos, Nigeria. The purpose of the study was to examine the relationship between emotional intelligence and academic achievement among senior secondary school students. Two research hypotheses guided the study. Quasi-experimental (pre-test/post-test control group) design was employed in the study. The sample consisted of 156 randomly selected participants

from three senior secondary schools. The schools were randomly assigned to the two treatment conditions emotional intelligence training technique and control group. The instruments for the study were Exploring and Developing Emotional Intelligence Skills Questionnaire (EDEISQ) two sections of 130-item instrument and a 60-item multiple choice objective test constructed by the researcher to measure achievement in Biology, English Language and Biology. The reliability coefficients of the instruments were 0.81 and 0.64. Hypotheses were tested using descriptive statistical method, analysis of covariance (ANCOVA) and Pearson product moment correlation coefficient. The study revealed that there is a positive relationship between emotional intelligence skills and academic achievement such that developing emotional intelligence skills of a student will lead to the enhancement of his/her academic achievement. The ex-post facto study was conducted in Lagos Nigeria.

Investigation study of Festus (2012) showed the relationship between emotional intelligence and academic achievement of senior secondary school students in the Federal Capital Territory, Abuja-Nigeria. The purpose of the study was to determine whether there is a significant relationship between emotional intelligence and academic achievement of students in Biology. Five research hypotheses guided the study. The instruments used for the correlation survey design study were the Emotional Intelligence Inventory for adolescents developed by Fani-Shing, Ying-Ming, Ching-Yua and Chia-An (2007) and Biology Achievement Test. The Emotional Intelligence Inventory has reliability coefficient of 0.79 while the Biology Achievement Test has reliability coefficient of 0.94. The population for the study was senior secondary school class 2 students in public schools in the Federal Capital Territory, Abuja, Nigeria. The sample for the study was 1160 SS2 students in public schools in the Federal Capital Territory, Abuja, Nigeria sampled by proportionate stratified sampling. Data were analyzed using mean and Pearson Product Moment Correlation. T-test was used to test the level of significance of the correlation coefficient. The result of the study showed that there was a significantly but low positive relationship between the emotional intelligence of SS2 students and their academic achievement in Biology. The result also indicated that there was a significantly low positive relationship between the emotional intelligence of SS2 students, urban school students, and rural school students, and their academic achievement in Biology. The study was conducted in Abuja Nigeria based on Facilitating Thought (FT), Emotional Management (EM), Emotional Perception (EP), Emotional Awareness (EA), Emotional Concern of Others (ECO), and Emotional Control (EC) as dimensions of emotional intelligence. However, the present study hinged on Bar-On's dimensions of emotional intelligence and determines its relationship with students' achievement in Biology in Enugu education zone, Enugu state, Nigeria.

### **Moderating Influence of Gender on Emotional Intelligence and Achievement**

In reviewing studies relating to gender and emotional intelligence, Adigwe (2015) studied the influence of emotional intelligence on problem solving achievement of secondary school chemistry students. The purpose of the study was to investigate the influence of emotional intelligence on problem solving achievement of secondary school chemistry students and to identify the influences of gender and school location on students' emotional intelligence. Seven hypotheses guided the study. Ex post facto design was adopted; the population was secondary school students in Nsukka Education Zone, who study chemistry. Stratified sampling technique was used to draw three urban and three rural schools from the three local government areas in the Education zone. The sample consisted of 310 students: 141 male students and 169 female students. Instrument for the study were a chemistry problem solving test consisting of fifty multiple-choice items based on problem solving in chemical stoichiometry, and Bar-On EQ -i YV self-report scale. These tests were administered to all the subjects and were collected on

the spot. 3x2x2 ANOVA and correlational analyses involving the achievement scores and the dimensions of emotional intelligence were made. It was found that emotional intelligence significantly influenced students' achievement in solving chemical stoichiometric problems, gender has no significant influence on the students' emotional intelligence, school location has no significant influence on the students' emotional intelligence, there is no significant interaction influence of gender and levels of emotional intelligence on students' achievement, there is no significant interaction influence of school location and levels of emotional intelligent on students' achievement, there is no significant interaction influence of gender and school location on emotional intelligence of the students , and there is no significant 3-way interaction of gender, school location and levels of emotional intelligence on students' achievement. Adigwe's study was conducted in Nsukka education zone in the subject of chemistry. However, the current study accessed emotional intelligence and its relationship with students' achievement in Biology, in Enugu education zone.

Further studies on gender and emotional intelligence by Umaru and Umma (2015) showed the effect of instruction in emotional intelligence Skills on locus of control and academic self-efficacy among junior secondary school students in Niger state, Nigeria. The purpose of the study was to determine the effect of instruction in emotional intelligence Skills on locus of control and academic self-efficacy among junior secondary school students in Niger state, Nigeria. Four research questions and four hypotheses guided the study. The study employed a quasi-experimental, non-equivalent control group, pre-test – post-test design. The population of the study was 105,034 secondary school students out of which 40 students were purposively sampled and used for the study. The instruments used for data collection were locus of control scale (LOCS) and Academic Self-Efficacy Scales (ASES). Data were analyzed using mean, standard deviation and t-test. The findings reveal that, Emotional intelligence skills was effective in moderating locus of control ( $t=23.98$ ,  $p=.000$ ) and improve academic self-efficacy ( $t=22.88$ ,  $p=.000$ ) of secondary school students. And there was no gender difference in the effect of emotional intelligence skills on locus of control ( $t=1.02$ ,  $p=.064$ ) and academic self-efficacy ( $t=3.41$ ,  $p=.003$ ) of respondents. The study showed that emotional intelligence skills such as emotional self- awareness, self-management, social-awareness and relationship management are very effective tools for re-addressing students with academic problems. The sample is 0.038% of the population of junior secondary school students in Niger state and purposively sampled instead of intact classes been used for the quasi experiment. However, besides the microscopic sample size, there was no account of an instrument which was used to collect data on emotional intelligence. The present study shall employ an adequate sample size; use a youth version of Emotional Quotient Inventory (EQ-i2.0) to access emotional intelligence while Biology Achievement Test (BAT) was used to collect students' achievement scores in Biology.

Studies carried out by Billings, Downey, Lomas, Lloyd, and Stough (2014) investigated emotional intelligence and scholastic achievement in pre-adolescent children. The purpose of the study was to investigate the relationship between ability EI and scholastic achievement in pre-adolescent children, using a newly created measure of EI for younger children – the Swinburne University Emotional Intelligence Test – Early Years (SUEIT-EY), a 68-item questionnaire designed to assess a four-factor model of EI in pre-adolescents. Four hypotheses guided the study. Scholastic achievement scores were standardized across schools using a 5-point scale where 5 was the highest score and 1 was the lowest score. These scores were computed for reading, writing, literacy, and maths/numeracy. Overall achievement was calculated by averaging students' literacy and numeracy scores. The study adopted correlational design. The sample comprised of 407 primary school students (200 males, 207

females) attending four primary schools in Melbourne, Australia between the ages of 9 and 13 years who were assessed on the SUEIT-EY, and scholastic results were collected for literacy and numeracy ability. Multiple Linear Regression Analyses was used to analyze data collected. Results indicated that a significant relationship exist between the 'Understanding and Analyzing Emotions' (UAE) branch of the SUEIT-EY and measures of achievement in literacy and achievement in numeracy, for boys and girls, over and above the effect of age. Sequential Multiple Linear Regression Analyses found earlier developing UAE abilities to better predict scholastic achievement variables than the more complex UAE abilities, and accounted for 11% of the variation of both literacy and numeracy scores. The subjects for the study were primary school pupils in Australia, but the present study assessed emotional intelligence in SS II students in Enugu education zone, Enugu State, Nigeria. Al-Rfou' (2012) investigated the relationship between emotional intelligence and instructional achievement of Tafilah Technical University Students, Jordan. The purpose of the study was to reveal the relationship between the emotional intelligence and academic achievement of Tafila Technical University students. Three hypotheses guided the study. The study adopted a correlational design. The sample of the study consisted of 210 students; of which there are 100 male students and 110 female students, who were chosen from different specializations using a stratified random sampling technique. The instrument for the collection of data was Bar-On's EQ-I (YV) scale. The reliability of the instrument clusters was 0.64, 0.68, 0.63, 0.55, 0.66, and 0.75 respectively. The Pearson correlation coefficient findings of the study revealed that there is no statistically significant difference due to gender, and for high achievers excluding the correlation between adaptability and academic achievement. The correlation study of Al-Rfou' was conducted in Jordan while academic achievement was determined on a general scale.

In the study carried out by Ogundokun and Adeyemo (2010) the moderating influence of emotional intelligence, age and academic motivation on academic achievement of secondary school students was investigated. The purpose of the study was to investigate the relationship between emotional intelligence and academic achievement among secondary school students. Five research hypotheses were employed to guide the study. The survey research involved 1563 secondary school students in Oyo state Nigeria (826 male and 737 female) as sample. The instrument for data collection were emotional intelligence behaviour inventory (EQBI) by Ashkanasy (2015), with Cronbach alpha reliability coefficient of 0.88, intrinsic and extrinsic motivation scale (IEMS) by Lepper, Corpus and Iyengar (2013), with Cronbach alpha reliability coefficient of 0.75, English language achievement test and Biology achievement test (BAT), with Cronbach alpha reliability coefficient of 0.77. Descriptive statistics, Pearson's product moment correlation and hierarchical regression were used to analyze the data. The findings of the study showed that emotional intelligence, age and academic motivation are mildly potent predictors of academic achievement. The study was conducted in Oyo state, Nigeria and took a pore on Ashkanasy's dimensions of emotional intelligence.

## RESEARCH METHOD

This chapter outlines the methodology employed in conducting the study, detailing the research design, area of study, population, sample and sampling techniques, instruments for data collection, validation and reliability of instruments, method of data collection, and method of data analysis.

### **Design of the Study**

The study utilized a Correlational survey research design, aiming to establish the relationship between students' emotional intelligence and their academic achievement in Biology. This design is suitable for exploring associations between variables, making it ideal for the study's objectives (Nworgu, 2015; Omachi, 2020).

### **Area of the Study**

The research was conducted in the Enugu Educational Zone of Enugu State, encompassing Enugu North, Enugu East, and Isiuzo Local Government Areas. This area was chosen due to observed issues of poor academic performance and high rates of truancy among students (Nworgu, 2016).

### **Population for the Study**

The population comprised 4825 SS II Biology students from 31 public secondary schools in the study area, consisting of 2813 males and 2012 females. SS II students were chosen due to their exposure to relevant biological concepts and their maturity in emotional indicators.

### **Sample and Sampling Technique**

A simple random sampling technique was employed, selecting one school randomly from each of the three local governments within the study area. This method ensured a representative sample size of 483 SS II Biology students from the selected schools, meeting the 10% condition proposed by Adigwe (2015).

### **Instrument for Data Collection**

Two instruments were utilized for data collection: the Youth Version of Emotional Quotient-Inventory (EQ-i2.0) and the Biology Achievement Test (BAT). The EQ-i2.0 assessed students' emotional intelligence across five clusters, while the BAT evaluated their knowledge of Biology concepts.

### **Validation of the Instrument**

Both instruments underwent validation by experts in relevant fields, ensuring their relevance and clarity for the study. Content validity was established through expert scrutiny, and reliability was assessed using Cronbach's alpha for the EQ-i2.0 and Kuder-Richardson's KR-20 for the BAT.

### **Method of Data Collection**

The instruments were administered to students with the assistance of their Biology teachers, who were briefed on the data collection process. This ensured consistency and accuracy in data collection procedures.

### **Method of Data Analysis**

Multiple linear regression analysis was employed to answer research questions and test hypotheses, with a significance level set at 0.05. This method allowed for the prediction of academic achievement in Biology based on students' emotional intelligence variables, providing insights into the relationship between these factors. Overall, the chosen methodology was robust and appropriate for investigating the research objectives, providing valuable insights into the dynamics of academic achievement in Biology among secondary school students.

## **RESULTS**

The results of this study were presented in this chapter according to the research questions and hypotheses that guided the study.

### **Research Question One**

What is the amount of variation in the students' achievement in Biology that can be attributed to each dimension of emotional intelligence (self-perception, self-expression, interpersonal skills, stress management and decision making)?

**Table 1:** Regression analysis of amount of variation in students’ achievement in Biology that can be attributed to each dimension of emotional intelligence

Variables	Correlation Coefficient (r)	Coefficient of Determination (r <sup>2</sup> )
Self-Perception	.61	.37
Self-Expression	.64	.41
Interpersonal Skills	.58	.34
Decision Making	.51	.26
Stress Management	.72	.52

(r) Correlation Coefficient (r<sup>2</sup>) = Coefficient of Determination

To answer research question one, the responses of the students on the different dimensions of emotional intelligence were correlated with their academic achievement in Biology. The result in Table 1 revealed that the correlation coefficient (r) of .61, .64, .58, .51 and .72 with associated coefficient of determinant (r<sup>2</sup>) of .37, .41, .34, .26 and .52 were obtained between students’ self-perception, self-expression, interpersonal skills, decision making and stress management and their achievement in Biology respectively. The coefficient of determinant (r<sup>2</sup>) implies that 37%, 41%, 34%, 26% and 52% variance in Biology achievement was predicted by students’ self-perception, self-expression, interpersonal skills, decision making and stress management respectively. Based on the result, it can be deduced that stress management with a coefficient of determinant (r<sup>2</sup>) of .52 i.e. (52%) was the amount of variation that best predicted students’ achievement in Biology. This was followed by self-expression with a coefficient of determinant (r<sup>2</sup>) of .41 (41%), then self-perception with a coefficient of determinant (r<sup>2</sup>) of .37 (37%), followed by interpersonal skills with a coefficient of determinant (r<sup>2</sup>) of .34 (34%) and lastly decision making with a coefficient of determinant (r<sup>2</sup>) of .26 (26%).

**Research Question Two**

What is the amount of variation in the students’ achievement in Biology that can be accounted for by all the dimensions of students’ emotional intelligence (self-perception, self- expression, interpersonal skills, stress management and decision making, altogether)?

**Table 2:** Model summary of the amount of variation in students’ achievement in Biology that can be accounted for by all the dimensions of their emotional intelligence jointly

Model	r	r <sup>2</sup>	Adjusted r <sup>2</sup>
1	.76	.58	.51

(r) Correlation Coefficient (r<sup>2</sup>) = Coefficient of Determination

Result in Table 2 revealed the amount of variation in students’ academic achievement in Biology that is accounted for by all the dimensions of emotional intelligence. From the Table, the result showed that a correlation

coefficient (r) of .76 was obtained between students’ academic achievement in Biology and all the dimensions of emotional. This means that, there exist direct positive relationships between students’ academic achievement in Biology and all the dimensions of emotional intelligence. Table 2 also revealed that, the coefficient of determination ( $r^2$ ) associated with the correlation coefficient of 0.58 was 0.52. This coefficient of determination ( $r^2$ ) indicates that 52% of variation in students’ academic achievement in Biology is attributed to all the dimensions of emotional intelligence. This was an indication that 48% of the variation in students’ academic achievement in Biology is attributed to other factors other than emotional intelligence.

**Hypothesis One**

The regression coefficient associated with the predictor variables (students’ self- perception, self-expression, interpersonal skills, decision making and stress management) in predicting students’ academic achievements in Biology are not significant.

**Table 5:** t-test analysis of significance of the regression coefficients associated with the predictor variables in predicting students’ academic achievement in Biology based on their emotional intelligence

<b>Coefficients</b>						
Model	<b>Unstandardized Coefficients</b>		<b>Standardized Coefficients</b>		Sig.	
	B	Std. Error	Beta	t		
1 (Constant)	28.59	4.314			6.63	.000
Self-Perception	.42	.047		.31	1.34	.000
Self-Expression	.44	.040		.34	1.28	.001
Interpersonal Skills	.39	.986		.22	1.58	.000
Decision Making	.34	.001		.19	1.03	.028
Stress Management	.53	.798		.49	2.17	.000

**a. Dependent Variable:** Achievement

The result in Table 5 shows that the t-values of 6.63, 1.34, 1.28, 1.58, 1.03 and 2.17 with associated probability values of .000, .000, .001, .000, .028 and .000 were obtained for students’ self-perception, self-expression, interpersonal skills, decision making and stress management respectively. Since the associated probability values for all the dimensions of emotional intelligence were less than 0.05 level of significance, the regression coefficients were all considered to be significant. Thus, the null hypothesis is rejected and the researcher concludes that the regression coefficient associated with the predictor variables (students’ self-perception, self-expression, interpersonal skills, decision making and stress management) in predicting students’ academic achievement in Biology are significant.

**Hypothesis Two**

Gender does not significantly moderate the prediction of students’ academic achievement in Biology by their emotional intelligence

**Table 6:** t-test analysis of the significant difference between the correlation coefficients of male and female students in the prediction of their academic achievement in Biology by their emotional intelligence

Variable (Gender)	N	R	Df	t	P-value
Male	282	.76	481	.814	.231
Female	201	.72			

To test hypothesis two, t-test analysis of significant difference between two samples correlation coefficients (r) of male and female students in prediction of their academic achievement in Biology by their emotional intelligence. Result in Table 6 shows the t- test for independent samples assuming equal variance. The results from the test shows  $t(481) = .814, P > 0.05$ . Thus, the  $H_0$  is not rejected since P-value is greater than 0.05. The researcher therefore, concluded that, gender does not significantly moderate the prediction of students’ academic achievement in Biology by their emotional intelligence.

**Hypothesis Three**

The regression model for predicting students’ academic achievement in Biology by their emotional intelligence is not significant.

**Table 7:** Analysis of variance of significance of the regression coefficients associated with the predictor variables in predicting students’ academic achievement in Biology based on their emotional intelligence

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	389.793	5	77.959	41.420	.002 <sup>a</sup>
Residual	26190.236	477	54.906		
Total	26580.029	482			

The result in Table 7 shows that an F-ratio of 41.420 with associated exact probability value of 0.002 was obtained for the significance of the regression model. This probability value of 0.002 was compared with 0.05 set as level of significance for testing the hypothesis and it was found to be significant. This is because the exact probability level of 0.002 is less than 0.05 level of significant. Thus, the null hypothesis was rejected. The researcher therefore, concludes that the regression model for predicting students’ academic achievement in Biology by their emotional intelligence is significant.

**Discussion of the Findings**

**Influence of Each Dimension of Emotional Intelligence on Students’ Achievement in Biology**

The researcher sought to investigate the influence of each dimension of emotional intelligence on students’ achievement in Biology. The findings of this study showed that stress management has the greatest influence on students’ achievement in Biology. This was followed by self-expression, then closely followed by self-perception, followed next by interpersonal skills and lastly decision making. A plausible explanation to this result was the premise that stress posed a great deal of psychological discomfort sufficient to deter learning. Therefore, its management will invariably promote maximum achievement. One’s expression is often related to one’s perception but interpersonal relationships can only be effective to the extent one’s perceptions and expressions are acceptable by others. Based on the result of this study, engaging approaches to stress management will yield greatest impact on students’ achievement in Biology by 52%, while self-expression will yield 41%, self-

perception 37%, interpersonal skills 34% and decision making yielding the lowest at 26%. Therefore, stress management is the most vital of all dimensions of emotional intelligence in predicting students' achievement in Biology. Least to consider, in predicting students' achievement in Biology is decision making. The result of this study agrees with the findings of Mendelson, Guity, Mantz and Mendelson (2016), that stress management and self-perception facets of emotional intelligence were the most influential on students' achievement while decision-making was the least influential.

### **Influence of Emotional Intelligence on Students' Achievement in Biology**

The researcher sought to investigate the influence of emotional intelligence on students' achievement in Biology. The result of this study revealed that there was a significant relationship between emotional intelligence and students' achievement in Biology. All predictor variables and jointly as emotional intelligence correlated positively with students' achievement in Biology. This implies therefore that emotional intelligence has an influence on students' academic achievement in Biology. It signifies that higher emotional intelligence increases students' achievement in Biology. The result of this study confirms the findings of Mendelson, Guity, Mantz and Mendelson (2016) that found out in their study that a significant positive correlation existed between unweighted GPA and EQ. Also, the finding of this study agreed with the findings of Durgut, Gerekan and Pehlivan (2013) who studied the impact of emotional intelligence on the achievement of accounting subject and found that emotional intelligence has a significant influence on students' achievement in accounting.

However, the findings of this study disagreed with the finding of Seng, Hanafi, Taslikhan and Raman (2016) who studied the influence of emotional intelligence on students' academic achievement and found no relationship existing between predictor variables and student's academic achievement. Also, the finding of this study does not totally agree with the finding of Festus (2012) who found a significantly low but yet positive relationship between emotional intelligence and student's academic achievement in Biology.

### **Conclusion**

The study set out to predict biology academic achievement of students using scores from emotional intelligence in Enugu Education Zone. Based on the findings of this study, the following conclusions were reached. Besides cognitive factors, emotional intelligence influence students' academic achievement in Biology. The very rigid IQ is not the only determinant of a students' academic success, therefore, since emotional intelligence can be improved by training, then enhancing the emotional intelligence of students may be a way of improving students' achievement in Biology. The findings of the study led to the conclusion that since stress management best predicts students' achievement in Biology while decision making least predicts, therefore more emphasis in stress management will increase students' achievement in Biology.

### **Recommendations**

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

1. Government should organize workshops and seminars for in-service teachers and teacher trainees to enable them understand the concept of emotional intelligence in order to develop their own emotional intelligence and that of their students.
2. Much emphasis should be placed on techniques to improve stress management skills in order to maximize achievement in Biology.
3. In planning and teaching of Biology, teachers should encourage gender equality and encourage the use of techniques that cater for the emotional needs of both males and females alike.

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