



Impact of metacognitive awareness and self-efficacy on academic performance of Biology students in Ifo Local Government Area of Ogun State

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Abstract

This study examined the impact of metacognition and self-efficacy on academic performance of students offering Biology. The research employed a correlational survey design. The population consisted of all senior secondary school students offering biology in Ifo Local Government Area of Ogun State. 180 SS2 students from six public secondary schools in Ifo LGA made up the sample. An adapted questionnaire by Schraw and Dennison (1994) on metacognitive awareness and self-efficacy scale by Gaumer Erickson and Noonan (2016) were used. We used descriptive and inferential statistics to analyze the gathered data. High levels of self-efficacy and metacognitive awareness were found in SS2 biology students. There was significant relationship between metacognitive awareness and self-efficacy, metacognitive awareness and self-efficacy had significant effect on the academic performance of the students. It was recommended that educators should organize seminars for the students as this will enhance their self- efficacy and strengthen metacognitive skills.

Key words: Biology, Metacognitive awareness, Self-efficacy, Academic performance

Introduction

Biology is a scientific discipline that examines the structure, function, growth, evolution, and distribution of organisms. As a scientific field, it systematically examines the existence of organisms. Utilizing the scientific method, it discerns verifiable facts and formulates theories grounded in experimental results pertaining to living creatures. Biology encompasses various disciplines. Biology is the examination of living organisms, including any system that may execute vital life processes (Agaba, 2016). Some research investigations have demonstrated that underperformance in science topics such as biology is connected to inadequate teaching techniques, metacognition and self-efficacy beliefs. Learning becomes more effective when students participate actively in critical thinking instead of simply absorbing information passively (Aninweze, 2018). Students actively create and expand their own knowledge by drawing on their preexisting experiences and beliefs. Students expand their knowledge or schema by building on what they already know. As a result, educators carry out their supervisory responsibility by helping students respond to leading questions in order to develop their cognitive abilities (Aliya, 2016).

Metacognition is a higher order mental skill that aids in problem solving, critical thinking, self-

evaluation of one's knowledge and the work at hand, and assisting learners in reaching a certain objective. It also assists individual student in making sure that the learning objective is being met (Arslan & Akin, 2014). Metacognitive knowledge and metacognitive regulation are the two components of metacognitive awareness. Metacognitive knowledge includes declarative, procedural, and conditional knowledge (Cera, Mancini & Antonietti, 2013). Declarative knowledge is one's understanding of the factors that affect learning as well as how we learn. Procedural knowledge refers to one's understanding of various memory and learning techniques and methods that are most effective for learners. Knowing the circumstances under which we can apply different cognitive techniques is known as conditional knowledge. Our knowledge as a whole includes our understanding of what we study, the greatest and most efficient techniques and tactics, as well as how and when to use them (Schraw & Dennison, 1994). Metacognition regulation refers to the real actions a student takes to improve memory and learning, like planning, assessing, and monitoring (Young & Fry, 2008). Metacognition can significantly aid in improving students' conceptual grasp in science and also contributes to better learning outcomes for students in science (Colthorpe *et al.*, 2018; Jahangard *et*

al., 2016). Metacognitive awareness and self-efficacy are important variables that determine the academic success of students. They are variables that make students aware of and believe in themselves.

One of the strongest and most consistent indicators of successful problem solving is self-efficacy, which Bandura (2013) defines as the confidence in one's capacity to strategize and carry out plans to achieve desired results. As related to academic performance, it is very important to talk about academic self-efficacy. According to Hayat *et al.* (2020), academic self-efficacy pertains to students' perception and attitudes about their potential for academic accomplishment as well as their confidence in their capacity to learn the subject and finish assignments. Self-efficacy can be defined as the believe in one's self to do well academically as a student. Research has demonstrated how crucial self-efficacy is for learning difficult subjects like biology and other sciences. Despite biology's widespread appeal, numerous studies have shown that students frequently performed poorly academically in this subject (Hasibuan & Djulia, 2017; Kusumawati, 2016). The results are consistent with the perception held by many students that science is a challenging subject to study (Ogunkola & Samuel, 2011). According to Buah and Akuffo (2017), the problem is present not only in universities but also in secondary schools. This condition is inherent to science, as learning science can be challenging due to its emphasis on organizing, integrating, synthesizing, and interpreting concepts or information (Ziegler & Montplaisir, 2014). One of the key factors that influence students' persistence and academic success is self-efficacy (Fakhrou & Habib, 2022). Studies have found that self-efficacy influences academic performance, motivation, and learning (Sadi & Uyar, 2013; Putwain, Sander & Larkin, 2013). Learners who exhibit higher levels of self-efficacy will perform better academically and demonstrate greater readiness and endurance compared to those who do not (Scherer, 2013).

Learners may not be able to reach their full potential in the classroom if they lack a clear understanding of who they are, what influence their academic performance, their best learning methods, and application of those methods. Many students struggle to understand their own thought and how to organize their actions; they are unable to comprehend tasks and keep track of procedures.

Self-efficacy is a belief about what you can do with your abilities rather than an assessment of them.

Furthermore, according to Stajkovic and Luthans (2018), self-efficacy is not a trait; there are no certain kinds of people who have high self-effectiveness and others who have low self-effectiveness. Though they sound similar, self-efficacy and self-esteem are two entirely separate ideas. The degree to which you think of yourself favorably, or how much you "esteem" yourself, is known as your self-esteem. On the other hand, self-efficacy is the conviction that you can achieve success in specific areas of your life, such as employment and education, among others (Collens *et al.*, 2023). Numerous mechanisms exist for self-efficacy to impact self-regulation, leading to improved performance and increased success (Maddux & Gosselin, 2012). Those who have higher levels of self-efficacy are more likely to overcome obstacles in order to achieve their goals (Maddux & Gosselin, 2012). For instance, those who have high academic self-efficacy are more likely to believe that their efforts will be rewarded, which helps them to encourage themselves to persevere despite hurdles like taking a challenging class and finishing their degrees. People who are self-efficacious think they have greater influence over a circumstance. Self-efficacious individuals may be more inclined to take the actions necessary to accomplish their objectives when they feel that they have greater control over a certain circumstance. Lastly, self-efficacious individuals are more confident in their capacity to solve problems, which enables them to employ their cognitive resources more effectively and make wiser choices particularly when confronted with obstacles and disappointments (Collens *et al.*, 2023). The most important skill that a student should be able to obtain from school is the capability to use an effective thinking, self-assessment, and problem-solving method to tackle the complex events and challenges of daily life, given the demands of an ever-evolving, complicated, and issue-laden world (Onu, 2015). Higher-order cognitive abilities enable students to think more clearly, independently resolve conflicts, participate in critical thinking, experiment, and challenge their own presumptions (Brown, 2017). In order to improve learning, assist students in comprehending and retaining information, and encourage their future involvement, it is important to support a variety of learning strategies. To optimize students' cognitive methods for learning, these programs usually prohibit pupils from hoarding vast volumes of information. Instead, it educates student ways to absorb new information by applying successful metacognition and self-efficacy beliefs. Shunck and

Zimmerman (2017) asserted that possessing knowledge and skills alone does not result in effective problem-solving in learning unless individuals have metacognitive awareness and confidence to utilize these personal resources. Students who believe they can succeed academically are more likely to be motivated in class. Students who have a high level of academic self-efficacy are more likely to work harder since they believe they can study effectively. Therefore, it is crucial to investigate the impact of metacognition and self-efficacy on the academic performance of biology students.

Research Questions

1. What are the levels of dimensions of metacognitive awareness among students offering biology?
2. What are the levels of metacognitive awareness and self-efficacy among biology students?
3. What is the relationship between dimensions of metacognitive awareness, self-efficacy and academic performance?
4. What is the composite effect of self-efficacy and metacognitive awareness on academic performance of biology students?

Research Hypotheses

H0₁: There is no significant relationship between dimensions of metacognitive awareness, self-efficacy and academic performance

H0₂: There is no significant effect of metacognitive awareness and self-efficacy on academic performance of students.

Methods

Correlational survey research design was employed for this study. All Senior Secondary School two (SSS2) Biology students in Ifo Local Government Area of Ogun State made up the population. One hundred and eighty (180) senior secondary school two biology students in public schools were purposively selected for the study. The study adopted the purposive sampling technique because students offering biology are few in schools in Ifo Local Government Area, so schools with students offering biology were sampled. In all, six schools were selected for the study. The research instrument was adapted questionnaire developed by

Schraw and Dennison (1994) for metacognitive awareness (The Metacognitive Awareness Inventory (MAI) is a 52-item test used to assess metacognitive awareness. Its elements were divided into eight subcomponents and grouped under two more general categories: Gaumer Erickson and Noonan's (2016) self-efficacy scale and understanding of cognition and regulation of cognition. The belief that ability increases with effort (subscale) consists of five items, while belief in personal ability (subscale) is represented by eight items. The performance scores of the students in biology were gotten from biology teachers of the selected schools. This was done after permission have been granted by the school administration. The reliability of the instrument was determined by administering the questionnaire to twenty students by using Cronbach Alpha Reliability test. The reliability coefficient of 0.73 and 0.82 was obtained for metacognitive awareness and self-efficacy respectively. The Statistical Package for Social Sciences (SPSS) version 22 was used to analyze the collected data. To answer the research questions, mean, median, standard deviation, frequency count, percentages and standard deviation were employed while Pearson Correlation and multiple regressions were used to test formulated hypotheses.

Results

Table 1: Demographic Distribution of the Respondents

| | | Frequency | % |
|--------|----------|-----------|-------|
| Age | Below 15 | 17 | 9.44 |
| | 15-20 | 131 | 72.78 |
| | 21-25 | 32 | 17.78 |
| | Total | 180 | 100 |
| Gender | Male | 79 | 43.9 |
| | Female | 101 | 56.1 |
| | Total | 180 | 100.0 |

The demographic distribution of the respondents by age and gender is presented in table 1. The result reveals that 17(9.44%) of the respondents are below 15 years, 131 (72.78%) fall within the age of 15-20 years and 32 (17.78%) are within the age of 21-25 years. Furthermore, male respondents are 79 (43.9%) and female respondents are 101 (56.1%).

Table 2: Level of Dimensions of Metacognitive Awareness among Students offering Biology

| | N | Mean | Standard. Deviation | Maximum | Minimum |
|--------------------------------------|------------|--------------|------------------------|--------------|--------------|
| Knowledge of cognition (KOC) | | | | | |
| Declarative knowledge | 180 | 6.68 | 1.13 | 8.00 | 4.00 |
| Procedural knowledge | 180 | 3.09 | 0.88 | 4.00 | 0.00 |
| Conditional knowledge | 180 | 3.79 | 0.84 | 5.00 | 1.00 |
| Total KOC | 180 | 13.56 | 1.79 | 17.00 | 8.00 |
| Regulation of cognition (ROC) | | | | | |
| Planning | 180 | 4.89 | 1.04 | 6.00 | 2.00 |
| Information | 180 | 6.98 | 1.30 | 9.00 | 2.00 |
| Comprehension | 180 | 5.03 | 0.92 | 6.00 | 2.00 |
| Evaluation | 180 | 3.78 | 0.80 | 6.00 | 1.00 |
| Debunking | 180 | 3.18 | 0.75 | 4.00 | 1.00 |
| Total ROC | 180 | 23.86 | 2.81 | 30.00 | 15.00 |

Table 2 shows levels of dimension of metacognitive awareness among students offering biology. The knowledge of cognition (KOC) ranged from 8.00 to 17.00 and median is 12.50. Since the mean value (13.56) is higher than median value (12.50), this indicates high level of knowledge of cognition among

the students offering biology ($\bar{X}=13.56$, $SD= 1.79$). The regulation of cognition (ROC) ranges from 15.00 to 30.00 and median is 22.5. Since the mean value (23.86) is higher than the median value (22.5), this indicates that the respondents have high regulation of cognition ($\bar{X}=23.86$, $SD= 2.81$).

Table 3: Levels of Metacognitive Awareness, Self-efficacy and Academic Performance of Students offering Biology.

| | N | Mean | Std. deviation | Maximum | Minimum |
|--|-----|-------|----------------|---------|---------|
| Metacognitive awareness Total (MAT) | 180 | 37.42 | 3.79 | 45.00 | 26.00 |
| Self-efficacy | 180 | 11.68 | 1.53 | 13.00 | 6.00 |
| Academic performance | 180 | 45.36 | 13.43 | 77.00 | 12.00 |

Table 3 shows levels of metacognitive awareness and self-efficacy of students offering biology. The metacognitive awareness ranged from 26.00 to 45.00 and median is 35.50. Since the mean value (37.42) is higher than median value (35.50), this

indicates high level of metacognitive awareness among the students offering biology. The self-efficacy ranged from 6.00 to 13.00 and median is 9.5. Since the mean value (11.68) is greater than median value (9.5), this indicates that the respondents have high self-efficacy.

Table 4: Correlation between Metacognitive Awareness Dimensions, Self-efficacy and Academic Performance of Students offering Biology

| | KOC | ROC | MAT | Self-efficacy | Academic performance |
|-------------------------|--------|--------|--------|---------------|-------------------------|
| KOC | 1 | 0.32** | 0.71** | 0.19** | -0.02 |
| ROC | 0.32** | 1 | 0.89** | 0.09 | 0.02 |
| MAT | 0.71** | 0.89** | 1 | 0.16* | 0.01 |
| Self-efficacy | 0.19** | 0.09 | 0.16* | 1 | 0.18* |
| Academic performance | -0.02 | 0.02 | 0.01 | 0.18* | 1 |

** . Correlation is significant at the 0.01 level (2-tailed).

KOC- Knowledge of cognition

*. Correlation is significant at the 0.05 level (2-tailed).

ROC-Regulation of cognition

The relationship between regulation of knowledge, knowledge of cognition, metacognitive awareness, academic performance and self-efficacy is presented in Table 4. There was significant positive

correlation between KOC and ROC ($r = 0.32, p < 0.01$); KOC and self-efficacy ($r = 0.19, p < 0.01$); self-efficacy and MAT ($r = 0.16, p < 0.05$); academic performance and self-efficacy ($r = 0.18, p < 0.05$).

Table 5: Regression Analysis of Metacognitive Awareness, Self-efficacy and Academic Performance

| Model | Unstandardized Coefficients ($R^2 = 0.034, F_{2, 177} = 3.117, P = 0.047$). | | Standardized Coefficients Beta | t | Sig. |
|---------------|--|----------------|-----------------------------------|-------|------|
| | B | Standard Error | | | |
| (Constant) | 28.647 | 11.591 | | 2.471 | .014 |
| Metacognition | -.066 | .265 | -.019 | -.248 | .804 |
| Self-efficacy | 1.642 | .659 | .186 | 2.492 | .014 |

a. Dependent Variable: ACADEMIC PERFORMANCE

Table 5 shows a positive non-significant impact of metacognition on the academic performance of biology students ($\beta = -.019, t = -.248$ and $p = 0.804$). Also, self-efficacy had a positive significant impact on academic performance of ($\beta = 0.186, t = 2.492$ and $p = 0.014$). Furthermore, the regression model shows R^2 value of 0.034, indicating metacognition and self-efficacy only account for 3.4% of the variance in academic performance of biology students. However, the model was significant ($F_{2, 177} = 3.117, P = 0.047$; $R^2 = 0.034$). This implies that metacognitive awareness and self-efficacy jointly predict the academic performance of students in biology.

Discussion

The findings from this study showed that students offering biology have high level of regulation of cognition and knowledge of cognition. This is an indication that the students utilize a significant amount of metacognitive knowledge and regulation in their academic pursuits. The overall level of metacognitive awareness among students offering biology is high. This suggests that students already have the required metacognitive awareness that can help them achieve better academic results. The findings of this study agrees with Kallio, Virta and Kallio (2018); Young and Fry (2008) who found that metacognition improve students' learning outcomes. Also, the study revealed a high level of self-efficacy among the students offering biology. This agrees with the findings of Sadi and Uyar (2013) who reported that the high self-efficacy suggests that students are more inclined to depend on their own abilities when confronted with difficult

problems, which lead them to put in greater effort and persevere longer to overcome obstacles.

A significant relationship was found between metacognitive awareness and self-efficacy. This agrees with the findings of Cheung (2015); Hayat & Shateri, (2019) that a strong association exists between metacognitive awareness and self-efficacy. Students who possess high self-efficacy are more inclined to utilize metacognitive strategies (Sadi & Uyar, 2013). Furthermore, the result showed that self-efficacy had significant relationship with knowledge of cognition. This indicates that self-efficacy influences students' thinking and affects the level of effort and persistence they apply to their learning (Hayat & Shateri, 2019).

An association between self-efficacy and academic performance found in this study is in agreement with Yazici, Seyisa & Altuna (2011); Al Demerdash (2020) who indicated that academic achievement of students can be predicted by self-efficacy. Britner (2016) stated that self-efficacy is pivotal for learning challenging subjects in sciences, as students start these courses with varying levels of apprehension and anxiety.

The study showed that there is a composite effect of self-efficacy and metacognitive awareness on academic performance of students offering biology. This agrees with Cikrikci and Odaci (2015) who found that awareness of metacognition and self-efficacy are indicators of life satisfaction. Nasri *et al.* (2014) stated that students who has a sense of self-efficacy are more inclined to utilize metacognitive strategies, which can naturally results in enhanced academic performance.



Conclusion

This study showed that the students have high level of metacognitive awareness and self-efficacy which make them to be successful in their academic pursuit. Also, there is a positive relationship between self-efficacy and metacognitive awareness. Students' belief in their own self-efficacy will likely result in a greater use of metacognition. Metacognitive awareness and self-efficacy jointly predict academic performance of students

Recommendations

1. Students should be taught and encouraged by their teachers to cultivate metacognitive awareness skills (planning, monitoring, evaluating, and revising their cognitive progress) as this will significantly aid them in gaining meaningful knowledge. Teachers should apply effective metacognitive awareness skills during teaching thereby improving students learning skills
2. Also, the school authority should organize seminars on metacognition and self-efficacy for the students as this will enhance their self-efficacy and strengthen their metacognitive skills.
3. Research on metacognition learning abilities should be supported by the government, and nongovernmental groups should be given the chance to educate learners about self-efficacy beliefs and metacognition, which will aid students in meeting their objectives as a learner.
4. Parents and educators should work to foster a positive learning environment at home and to inspire students in believing in themselves. It is recommended that educators set aside time to engage with students and evaluate their performance on assessments, homework, and exams.

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