



## Metacognition and Self-Efficacy Belief as Determinants of Students Achievement in Biology in Isuikwuato Local Government Area of Abia State

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### Abstract

The study examined Metacognition and Self-Efficacy Belief as Determinants of Students Achievement in Biology in Isuikwuato Local Government Area of Abia State. Two research questions were raised and two hypotheses formulated to guide the study. The study adopted a correlation design. Sample size of 240 Biology students was used for the study, drawn using simple random sampling technique. The instruments used for data collection were questionnaire and Biology achievement test. The reliabilities of the instruments were established using Cronbach alpha and Kuder Richardson (KR20) methods. Reliability indices of 0.83, 0.90 and 0.87 were gotten for metacognition, self-efficacy belief and achievement test respectively. Pearson Product Moment Correlation Coefficient was used to answer research questions and the hypotheses were tested using linear regression analysis. Results of the analysis revealed that; there is a high positive relationship between Metacognition and self-efficacy belief on students' academic achievement in Biology. Based on the findings the following recommendations were made among others: Teachers and parents should endeavor to encourage and motivate learners to believe in themselves, create conducive environment at home. Parents should not label any students or children negatively so as not to weaken their morale not to believe in themselves.

**Keywords:** Metacognition, Self-Efficacy belief, Achievement in Biology

### Introduction

Biology is a branch of science that primarily deals with the structure, function, growth, evolution, and distribution of organisms. As a science, it is a methodological study life of living things. It determines verifiable facts or formulates theories based on experimental findings on living things by applying the scientific method. Biology encompasses diverse fields, including botany, conservation, ecology, evolution, genetics, marine biology, medicine, microbiology, molecular biology, physiology, and zoology. Biology is simply defined as the study of living things which has to do with any system capable of performing functions such as eating, metabolizing, excreting, breathing, moving, growing, reproducing, and responding to external stimuli (Agaba, 2016).

It is an important science subject in senior secondary school that deals with the origin, history, physical characteristics, life processes, and habits of living organisms. Like other scientists, biologists use the scientific method to make observations, pose questions, generate hypotheses, perform experiments, and form conclusions. There are many facets that point to the importance of biology. The science of biology is mainly studying about life. It provides an in-depth,

scientific understanding of how all living and nonliving organisms interact with each other. It also gives insights into how diverse life forms are.

Moreover, Biology encompasses other fields of research that are related to the sustainability of life, including the environment, ecosystem, food quality, causes of illnesses, the development of medicines, the study of the human body. The study of biology gives a learner an in-depth understanding of the natural world, also a background on how to conduct research, solve problems, organize, and think critically.

Despite the relevant of Biology to the society, research findings have shown that biology has recorded poor achievement. Achievement according to Odo (2021) is defined as the extent or degree of attainment of students in tasks, courses or programmes to which they were sufficiently exposed. Usman (2017) defines academic achievement as the measure of students' learning acquisition of teaching and learning activities. Unfortunately reports from scholars and educators indicated that academic achievement in biology in the external examination is poor (Eze, 2017). Poor achievement in biology can be attributed to many factors such as unavailability of laboratory facilities,

lack of instructional materials, inadequate time allocation, large class size and poor instructional delivery approaches (Aninweze, 2018); lack of parental support, teachers' incompetence and ineffective school teaching approaches and lack of laboratory equipment (Aliyu, 2016).

The poor achievement in Biology is not only caused by lack of relevant knowledge, but it is also the result of poor learning and memory strategies. The report of the Chief examiner for West African Examinations Council for year 2019-2022 indicates that the number of students that passed biology at credit level (A<sub>1</sub>-C<sub>6</sub>) as consistently less than 50% for the past four years (2019-2022) in Nigeria (West African Examination Council, 2022). Some research studies have shown that under achievement in science subjects such as biology is linked to inappropriate methods of teaching metacognition and self-efficacy belief. Learning is more effective when students are actively engaged critical thinking rather than receiving knowledge passively (Aninweze, 2018). Learners actively, construct and build knowledge for themselves based on their belief prior experiences. Learners build upon what they already know and add to their knowledge or schema. Therefore, the teachers perform supervisory role of guiding students to answer leading questions in order to develop higher cognitive skill (Aliyu, 2016).

Higher order cognitive skills, such as ability to elaborate, synthesize, analyze, apply, and evaluate specific learning information are very necessary for one to achieve academic success and adjustment in life. With the increasing demand of an ever changing and challenging problem-ridden world, the least any learner ought to acquire from school is the ability to utilize an efficient thinking self-monitoring and problem solving strategy to face the complex situation and challenges of everyday life (Onu, 2015). Higher order cognitive skills help learners to think more effectively, manage conflict by themselves, engage in practical thought, experiment, and question their own basic assumptions (Brown, 2017). Thus different learning strategy should be encouraged to help students learn better, understand, and retain concepts and promote their future involvement. The most common approach of these programme is to discourage learners from storing vast amounts of facts, but rather they should "learn how to learn" new information by applying effective metacognition and self-efficacy belief which will maximize learners' cognitive strategies in knowledge acquisition. Shunck and Zimmerman (2017) argue that

"having knowledge and skill does not produce high-quality problem solving in learning, if people lack metacognition, and self-efficacy assurance to use these personal resources.

Learning is a key process in human behaviour. It is a step -by -step process in which an individual experiences permanent, lasting changes in knowledge, behaviours or ways of processing the world (Wind, 2016). Onu (2015) defined learning as a process of one's efforts to acquire a new change in behavior, as a result of one's own experience in interaction with their environment. A learning process that is capable of maximizing learners' cognitive strategies in knowledge acquisition involves the individual's metacognition. Metacognition is an awareness of one's own thought processes and an understanding of the patterns behind them. Metacognition can take many forms, such as reflecting on one's own ways of thinking and knowing when and how to use particular strategies for problem-solving.

Metacognition refers to one's knowledge concerning one's own cognitive processes or anything related to them. It also refers to awareness of one's own knowledge—what one does and does not know—and one's ability to understand, control, and manipulate one's cognitive processes (Wind, 2016). It can also be processes used to plan, monitor, and assess one's understanding and performance. Metacognition includes a critical awareness of (a) one's thinking and learning and (b) oneself as a thinker and learner. It refers to a range of processes and strategies used to assess and monitor knowledge. It includes the "feeling of knowing" that accompanies problem solving, the ability to distinguish ideas about which we are confident from those which we doubt (Tarricone, 2011).

It involves knowing when you know, knowing when you don't know, and knowing what to do when you don't know. In other words, it involves self-monitoring and correcting your own learning processes. For example, you engage in metacognition if you notice that you are having more trouble learning concept A than concept B, or if you realize that your approach to solving a problem is not working, and you decide to try a different approach.

Metacognition also involves knowing yourself as a learner; that, knows your strengths and weaknesses as a learner. For example, if you can explain what your strengths are in academic writing, or exam taking or other types of academic tasks, then you are metacognitively aware.

Metacognitive processes can be applied to learning and thinking in all disciplines and contexts. It is an essential skill for life-long learning, and therefore, metacognitive skills need to be taught and discussed with students. A metacognitive approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them” (Bransford, 2010).

Metacognition helps students to become independent learners. It helps learners to monitor their own progress and take control of their learning as they read, write and solve problems in the classroom. Metacognition has a positive impact on learning. By making a unique contribution to learning over and above the influence of intellectual ability. Learners who use metacognitive strategies are likely to be able to achieve more. Research shows that improving a learner’s metacognitive practices may compensate for any cognitive limitations.

Metacognition takes the children beyond their capabilities and helps them question themselves. Metacognitive knowledge also makes children more self-aware and reliant, thus making them better individuals. This is especially important for students learning biology, because improved metacognition is expected to enhance learning and performance (Young & Fry, 2018) for all students. Also, students with awareness and control of their own thinking can learn more and perform better than students who are not metacognitive.

Students with strong metacognitive skills can identify concepts they do not understand and select appropriate approaches to learn those ideas. Metacognitive students know how to implement selected strategies, and they modify their approaches based on experience. These metacognitive skills can have a profound effect on learning. Metacognitive have been suggested to be an instrument for enhancing self-efficacy believe of the learners.

Self-efficacy refers to an individual's belief in his or her capacity to execute behaviors necessary to produce specific performance attainments (Bandura, 1977, 1986, 1997). Self-efficacy reflects confidence in the ability to exert control over one's own motivation, behavior, and social environment. The term “self-efficacy” refers to your beliefs about your ability to effectively perform the tasks needed to attain a valued goal. Self-efficacy does not refer to your abilities but to how strongly you believe you can use your abilities to work toward goals.

Self-efficacy does not refer to your abilities but rather to your beliefs about what you can do with your

abilities. Also, self-efficacy is not a trait—there are not certain types of people with high self-efficacies and others with low self-efficacies (Stajkovic & Luthans, 2018). Self-efficacy may sound similar to a concept “Self-Esteem”, but these are very different notions. Self-esteem refers to how much you like or “esteem” yourself—to what extent you believe you are a good and worthwhile person. Self-efficacy, however, refers to your self-confidence to perform well and to achieve in specific areas of life such as school, work, among others.

The term “self-efficacy” refers to your beliefs about your ability to effectively perform the tasks needed to attain a valued goal. Self-efficacy does not refer to your abilities but to how strongly you believe you can use your abilities to work toward goals. Self-efficacy is not a unitary construct or trait; rather, people have self-efficacy beliefs in different domains, such as academic self-efficacy, problem-solving self-efficacy, and self-regulatory self-efficacy. Stronger self-efficacy beliefs are associated with positive outcomes.

Imagine two students, Nedu and Chika, who are about to take the same math test. Nedu and Chika have the same exact ability to do well in math, the same level of intelligence, and the same motivation to do well on the test. They also studied together. They even have the same brand of shoes on. The only difference between the two is that Sally is very confident in her mathematical and her test-taking abilities, while Lucy is not. So, who is likely to do better on the test? Nedu, of course, because she has the confidence to use her mathematical and test-taking abilities to deal with challenging math problems and to accomplish goals that are important to her—in this case, doing well on the test. This difference between Nedu and Chika—the student who got the A and the student who got the B-, respectively—is self-efficacy. As you will read later, self-efficacy influences behavior and emotions in particular ways that help people better manage challenges and achieve valued goals.

The concept that was first introduced by Albert Bandura in 1977, since then self-efficacy has become one of the most thoroughly researched concepts in psychology. Just about every important domain of human behavior has been investigated using self-efficacy theory (Maddux & Gosselin, 2012). Self-efficacy does not refer to your abilities but rather to your beliefs about what you can do with your abilities. Also, self-efficacy is not a trait—there are not certain types of people with high self-efficacies and others with low self-efficacies. Rather, people have self-efficacy beliefs

about specific goals and life domains. For example, if you believe that you have the skills necessary to do well in school and believe you can use those skills to excel, then you have high academic self-efficacy.

Self-efficacy influences self-regulation in many ways to produce better performance and greater success (Maddux & Gosselin, 2012). First, people with stronger self-efficacies have greater motivation to perform in the area for which they have stronger self-efficacies (Bandura, 1997). This means that people are motivated to work harder in those areas where they believe they can effectively perform. Second, people with stronger self-efficacies are more likely to persevere through challenges in attaining goals (Maddux & Gosselin, 2012). For example, people with high academic self-efficacies are better able to motivate themselves to persevere through such challenges as taking a difficult class and completing their degrees because they believe that their efforts will pay off. Self-efficacious people believe that they have more control over a situation. Having more control over a situation means that self-efficacious people might be more likely to engage in the behaviors that will allow them to achieve their desired goal. Finally, self-efficacious people have more confidence in their problem-solving abilities and, thus, are able to better use their cognitive resources and make better decisions, especially in the face of challenges and setbacks.

Students who believe in their ability to do well academically tend to be more motivated in school and such students with high academic self-efficacies might study harder because they believe that they are able to use their abilities to study effectively. In view of this, learner's self-efficacy belief and their metacognition need to be looked into and ascertain the extent of relationship with students' academic achievement.

### Research questions

In order to address the problem of this study, the following research questions guided the study.

- (a) What is the extent of relationship between metacognition and students' academic achievement in Biology?
- (b) What is the extent of relationship self-efficacy belief and student academic achievement in Biology?

### Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

H<sub>01</sub>: There is no significant relationship between metacognition and students' academic achievement in biology.

H<sub>02</sub>: There is no significant relationship between self-efficacy belief and students' academic achievement in biology.

### Method

This study adopted correlation research design. The study was conducted in Isuikwuato L.G.A of Abia State, Nigeria. The population of this study consisted of 1,623 SS II Biology students in 12 public secondary schools in Isuikwuato LGA of Abia State. A total of 240 SS II Biology students in six (6) public secondary schools in Isuikwuato constituted the sample of this study. Simple random sampling technique was used to sample six (6) schools and 40 students were sampled from each of the schools given a total of 240 students.

The instruments for data collection were questionnaire and Biology achievement test. The questionnaire was designed to collect data on Metacognition and self-efficacy belief. The metacognition items were adopted from Marsh (2003) meta-cognition questionnaire that is made up of 20 items and self-efficacy questionnaire which was adopted from Fraenkel and Wallen (1990) self-efficacy questionnaire that is 20 items. The questionnaire is sectioned. Section A consists of the students' bio data while section B consists of the items statement. The questionnaire was rated in four point scale of Very high extent (4), High extent (3) Low extent (2) and Very low extent (1). The achievement test was adopted from WASCE past question paper in Biology which made up of 20 items.

Face validity of the questionnaire was carried out by giving the questionnaire to three experts in Biology, Psychology, and Measurement and Evaluation all in Michael Okpara University of Agriculture, Umudike. The reliability of the questionnaire was established using Cronbach alpha which gave reliability index of 0.83 for metacognition and 0.90 for self-efficacy belief while the achievement test reliability was established using Kuder-Richardson (KR-20) formula to determine the internal consistency with reliability index of 0.87.

The questionnaire was first administered to the respondents through the help of the class teachers of the schools sampled. After the administration of the questionnaire and collected at the same time. The same sampled students were as well administered with the achievement test and as well collected the same day to



enhance 100% recovery of the instrument. The instruments were collated and analysis using Pearson Product Moment Correlation Coefficient to answer the research questions while Linear Regression analysis was used to test the null hypothesis at 0.05 level of significance.

**Decision Rule:** The bases for the decision for the research questions' conclusion was as follows: 0.00=no relationship, 0.01-0.19=very low relationship,

0.20-0.39=low relationship, 0.40-0.59=moderate relationship, 0.60-0.79=high relationship, 0.80-0.99=very high relationship and 1.00=perfect relationship (Uzoagulu, 211). The acceptance or rejection of null hypotheses was based on the calculated value of the t-test of correlation coefficient "r". When the t-calculated is greater than the t-tabulated, the null hypothesis was rejected but if otherwise, the null hypothesis was accepted.

## RESULTS

**Table 1 Extent of relationship between Metacognition and students' academic achievement in Biology**

		Metacognition	Achievement
Metacognition	Pearson Correlation	1	.629**
	Sig.(2.tailed)		.000
	N	240	240
Achievement	Pearson Correlation	.629**	1
	Sig.(2.tailed)	.000	
	R <sup>2</sup>	.523	
	N	240	240

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

Data in Table 1 indicated a correlation coefficient (r) of .629 which is a high positive correlation and is within the coefficient limit of +/- 0.60-0.79 as high positive extent relationship. This indicates that metacognition relate to students' academic achievement. The percentage coefficient of

determination (R<sup>2</sup>) .523 shows that 52% of the variations in students' achievement in Biology could be attributed to the students' metacognition. This implies that high metacognition of students leads to a higher academic achievement in biology, therefore students' achievement in biology have a relationship with their metacognition.

**Table 2 Regression analysis of relationship between Metacognition and students' academic achievement in biology**

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	1170.660	1	1170.660	267.024	.000 <sup>a</sup>
Residual	69149.884	238	145.886		
Total	70320.544	239			

correlation is significant at 0.05 level (2 tailed)

Table 2 revealed that F-calculated value of 267.024 at 0.05 level of significance. The table also shows that the P-value of .000<sup>a</sup> which is less than the alpha value at 0.05; thus null hypothesis which states that there is no significant relationship between Metacognition and students' academic achievement in

biology is rejected and upheld that there was significant relationship between Metacognition and students' academic achievement in biology. This implies that metacognition to high extent relates to students' academic achievement in Biology.

**Table 3: Relationship between self-efficacy belief and students' academic achievement in Biology**

		Self-efficacy	Achievement
Self-efficacy	Pearson Correlation	1	.748**
	Sig.(2.tailed)		.000
	N	240	240
Achievement	Pearson Correlation	.748**	1
	Sig.(2.tailed)	.000	
	R <sup>2</sup>	.620	
	N	240	240

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

Data in Table 3 indicated a correlation coefficient (r) of .748 which is a high positive correlation and is within the coefficient limit of +/- 0.60-0.79 as high positive extent relationship. This indicates that self-efficacy belief relate to students' academic achievement. The percentage coefficient of

determination (R<sup>2</sup>) .620 shows that 62% of the variations in students' achievement in Biology could be attributed to the students' self-efficacy belief. This implies that high self-efficacy belief of students leads to a higher academic achievement in biology, therefore students' achievement in biology have a relationship with their self-efficacy belief.

**Table 4 Regression analysis of relationship between self-efficacy belief and students' academic achievement in biology**

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	29522.907	1	29522.907	343.007	.000 <sup>a</sup>
Residual	40797.637	238	86.071		
Total	70320.544	239			

correlation is significant at 0.05 level (2 tailed)

Table 4 revealed that F-calculated value of 343.007 at 0.05 level of significance. The table also shows that the P-value of .000<sup>a</sup> which is less than the alpha value at 0.05; thus null hypothesis which states that there is no significant relationship between self-efficacy belief and students' academic achievement in biology is rejected and upheld that there was significant relationship between self-efficacy belief and students' academic achievement in biology. This implies that self-efficacy belief to high extent relates to students' academic achievement in Biology.

### Discussion of the findings

The result showed that there is a high positive relationship between metacognition and students' academic achievement in biology. The corresponding hypothesis affirmed that there was significant relationship between metacognition and students' academic achievement in Biology. This finding is in agreement with the study of Young and Fry (2018) who investigated the effect of instruction in metacognitive skills on mathematics self-efficacy belief, interest and

achievement of low-achieving mathematic students in Kogi state Nigeria. The finding reported that instructing students in metacognitive skills significantly enhanced their interest and achievement in mathematics. In the present study it was established that there was relationship between metacognition and students' achievement in Biology, which implies that students with high metacognition achieved better than students with low metacognition.

The result also showed that there is a high positive relationship between self-efficacy belief and students' academic achievement in Biology. The corresponding hypothesis affirmed that there was significant relationship between self-efficacy belief and students' academic achievement in biology. This finding is in agreement with the study of Aliya (2016) who examine the influence of self-efficacy Belief on Interest and Academic Achievement of Adolescent students in mathematics. The finding revealed that self-efficacy belief has a positive and significant influence on interest in mathematics. In the same vein Odo (2021) reported that there was a positive relationship between

Self-concepts and academic achievement in Biology. In the present study it was established that there was relationship between self-efficacy belief and students' achievement in Biology, which implies that students with high self-efficacy belief achieved better than students with low self-efficacy belief.

### Conclusion

Based on the findings of the study it was concluded that students' metacognition has a positive relationship with the students' academic achievement in biology. Students with high metacognition are likely to perform better than students with low metacognition. The students' achievement in biology is predisposed on their self-efficacy belief, that students with high self-efficacy belief will likely achieve better in biology than students with very low self-efficacy belief. Therefore, there is a positive relationship between biology students' self-efficacy belief and their academic achievement.

### Recommendations

In line with the findings of this study, the researcher made the following recommendations.

1. Teachers should be encouraged to make learning, student-centered and not teacher- centered. They should ensure that students are actively involved in the learning activity by ensuring their active participation and their lesson should be organized in such a way that students can bring their own related experiences to bear on the lesson and ask question, make predictions and examine their own answers in order to be actively involved in the learning processes.
2. Teachers and parents should endeavor to encourage and motivate learners to believe in themselves, create conducive environment at home. They should bring out time to interact with the learner and assess their performance in tests, assignments and examinations.
3. Teachers and parents should not label any students or children negatively so as not to weaken their morale not to believe in themselves.
4. Government should sponsor researches on metacognition learning skills and non-governmental organizations to provide opportunities for learners to know more about metacognition and self-efficacy belief that will help students to achieve their learning goals.

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