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EXPLORING THE METACOGNITION OF IN-SERVICE SCIENCE TEACHERS IN NORTH-EASTERN NIGERIA

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ABSTRACT

Teachers should understand the principles about how students learn and they should be aware of their own metacognitive abilities. Metacognition does not only work for the students but it helps the teachers to improve their teaching skills. The purpose of this study is to explore the metacognition of in-service science teachers at the secondary school level. The design for the study is a correlational survey research design. Two objectives guided the study and two research questions were answered. Three states were sampled at random and all secondary schools within the state's capital metropolis. The sample for the study involves science teachers selected using purposive sampling techniques. The instruments used for data collection were the Metacognitive Awareness Inventory for Teachers (MAIT) and Students' records of achievement. The data were analyzed using mean, standard deviation, and Pearson product-moment correlation coefficient. The result indicates that science teachers have a moderate level of metacognitive awareness and science teachers' metacognitive awareness influenced their students' achievement. It was recommended among others that teachers' metacognitive awareness should be enhanced.

Keywords: Metacognition, Survey Research Design, Cognitive knowledge, North Eastern Nigeria, Metacognitive regulatory skill,

Biography of the Author

Sa'adatu Abubakar Mohammed is a wife and a mother of five Children from Kaduna state, Zaria Local Government Area. I am a holder of Nigerian Certificate in Education with qualification of Math/physics in 1996 from FCE Zaria, B. Sc. (Ed) Physics in 2001 from ABU Zaria, M. Tech. (Ed) Physics in 2009 and Ph. D Science Education in 2015 from ATBU Bauchi respectively. I am presently a reader in Physics Education with Abubakar Tafawa Balewa University, Bauchi

1.0 INTRODUCTION

The growing emphasis on student/learner-centered teaching at various educational levels including universities has led to recommendations for encouraging teachers on metacognitive awareness (Kistner, Rakoczy, Otto, Dignath-van Ewijk, Buttner, Klieme, 2010; Abdellah, 2015; Kohen and Kramarski, 2018). Furthermore, metacognition is a value-added construct that makes teachers reflect on the basis and the process of their teaching in addition to the

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norm of solving problems and engagement in the teaching process (Ellis Denton, Bond, 2014; Avargil, Lavi, Dori 2018). Essentially, metacognition has a focus on the active participation of an individual in his or her teaching activities. In Nigeria, promoting teachers' metacognitive knowledge and metacognitive regulatory skills is part of the recommendations for improving the declining performance in secondary level public examinations (Okoza Aluede, & Owens-Sogolo, 2013; Ijiga, 2014; Maduabuchi, Angela, 2016; Gengle, Abel, Mohammed 2017). Thus, at the post-secondary level in Nigeria, explicit instruction on metacognition would help improve the metacognitive knowledge and metacognitive regulatory skills that learners exhibit. Studies on metacognition and learning in Nigeria have been limited with emphasis on secondary students (Nbina and Viko, 2010; Adedipe and Ofodu, 2011; Onu, Eskay, Igbo, Obiyo & Agbo 2012; Eluemuno, Azuka-Obieke, 2013; Okoza Aluede, & Owens-Sogolo, 2013; Ijiga, 2014; Ajaja and Agboro-Eravwoke, 2017).

Metacognition is higher-order thinking which plays a crucial role in learning and teaching practices in the education system (Karaduman & Erbas, 2017). Metacognition refers to both people's awareness and control, not only of their cognitive processes but of their emotions and motivations (Louca, 2003). Specifically, Flavell is one of the first theorists who put forward a definition of metacognition. He classified metacognition into metacognitive knowledge, metacognitive experience, and metacognitive monitoring and control (Efklides, 2006). It is assumed that effective control of learning cannot occur in the absence of accurate monitoring. Metacognitive skills need high intellectual abilities exceeding limits of tangible thinking that guided activities and experience in teaching and learning processes.

Metacognition includes two kinds of higher-order thinking: knowledge of cognition and regulation of cognition (Ma & Baranovich, 2015). Knowledge of cognition refers to what we know about our cognition and about our thinking and learning. It consists of declarative knowledge, procedural knowledge, and conditional knowledge skills (Schraw, 1998). In short, knowledge of cognition refers to knowing about our thinking, but regulation of cognition refers to actively guiding our thinking (Young & Worrell, 2018). Jia and Cao (2019) explain that metacognition refers to the knowledge and regulation of one’s own cognitive processes, which has been regarded as a critical component of creative thinking. (Schraw, Crippen, & Hartley 2006). Meanwhile, regulation of cognition typically comprises planning, monitoring, and evaluation.

Considering that science subjects are perceived as subjects that are hard to understand, if teachers know their level of thinking, monitor the thinking process, use appropriate teaching strategies in order to cope with difficulties and self-assessment will facilitate reflective thinking. Paris and Winograd (1990) relate metacognition to a mirror on the knowledge and thoughts of a person in a way that the reflection can either come from the inside of an individual as well from previous knowledge. Thus, teachers should be encouraged to determine the difficulty of a task by effectively monitoring their perception, plan their teaching activities, monitor and assess themselves their success in teaching (Wagner & Stemberg, 1984). In addition, for successful learning, teachers should know what the learning strategies are, their requirements and when, why, and how to use them.

Teachers should plan, monitor, and assess the teaching process considering the personal differences of the students. Teachers should use their knowledge of cognition and skills effectively in the planning of a lesson, determining whether a teaching approach is as useful

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as expected, changing it when it is not useful, and evaluating the teaching process at the end of the lesson. In other words, the effectiveness of the teaching process is closely related to teachers' skills of using their knowledge of cognition and skills before, during and after the lesson. At this point, teachers with low metacognitive awareness will fall short of supporting knowledge of cognition and skills of their students in the effective teaching and learning process. Thus, the metacognitive awareness of science teachers should be high for qualified science teaching. In this direction, the initial aim of the study was to explore in-service science teachers'metacognition in North-East Nigeria.

2.0 STATEMENT OF PROBLEMS

Students' performance is always deteriorating due to the fact that teachers fail to monitor and control their own thinking in teaching processes. Regulation of thinking makes teachers to know why, how, when, and where to apply their knowledge and skills in teaching activities.Azevedo(2009); de Boer Donker, Koston, and van der Werf, (2018); and Young and Worrell (2018)states that in educational contexts, metacognition is continually used to explain the process by which teachers learn to understand their thinking, with the notion that if they can regulate their thinking effectively, there will be better instructions and understanding. Several studies focused on students' metacognition, but only a few take into account the teachers' Metacognitive awareness and were at pre-service level, and there are even limited studies where both teachers and students were examined. Few out of these studies takes into consideration the examination of in-service teacher metacognition. For teachers to be able to teach students to think in a metacognitive way, they must be metacognitivethemselves, as well as be clearly aware of their metacognitionlevels and characteristics. When it comes to teacher metacognition, researchers suggest that effective teachers are "more metacognitive" (Duffy, Miller, Parsons,& Meloth, 2009) or possess "adaptive metacognition" which involves both the adaptation of self and environment in response to multifarious classroom variability (Lin, Schwartz, & Hatano, 2005; Manasia, 2015). Hence, using metacognition will assist teachers to realize their strengths and weaknesses at different aspects of teaching activities. For that reason, the present research aimed at exploring in-service teachers' metacognition in North-East Nigeria.

3.0 LITERATURE REVIEW

Metacognition is a process that encourages in-depth thinking of oneself in a situation and is made effective from the thinking process of one-self (Flavell, 1979). It is defined as the ability of individuals to reflect, understand, and control their own thinking, learning, and acting. It is a cognitive process to control their own thinking activity with planning, monitoring and evaluating. Also, the development of the learner metacognition is a process of reflection on the thinking processes of analysis, synthesis, and problem-solving during teaching and learning activities (Brown, 1987). These general issues of metacognition have been analyzed in detail and broken down into very specific components, such as declarative knowledge, procedural knowledge, planning, monitoring, and evaluation(Ajaja, and Agboro-Eravwoke, 2017).

Seraphin, Philippoff, Kaupp, and Vallin (2012) studied the impact of professional development on metacognition and learning in science education. They modified a selection of the Metacognition Awareness Inventory (MAI) (Schraw & Dennison, 1994) using

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questionnaires for both teachers and students. In addition, teachers were asked to respond to ten statements from the MAIT. The results of the analysis suggested that the ability to evaluate cognitive strengths and weaknesses is possible among teachers and students and they can learn to use that knowledge strategically. Both novice and experienced teachers benefited from a metacognition-focused scientific inquiry in their professional development. The results also suggest that teachers need to be supported in their metacognitive development. Ghonsooly, Khajavy, and Mahjoobi (2014) used the MAIT and Teachers' Sense of Self-Efficacy Scale (TSES) (Woolfolk & Hoy, 1990) in their study to investigate the predictability of the teacher trainees' academic achievement based on their scores in self-efficacy and metacognition. Furthermore, the difference between the self-efficacy and metacognition of males and females was investigated. The results of the Path Analysis indicated that both metacognition and self-efficacy have an influence on academic performance, with metacognition having a stronger effect. Moreover, no differences between male and female self-efficacy and metacognition were found per the results of the t-test. In Malaysia, samples of 52 science teachers were asked to answer the MAIT. The results of this study disclosed that science teachers have a high level of perception about metacognition. No significant differences have been found in Malaysia related to teachers' gender or age, although an interaction between teachers' age and educational level was predictable (Mai, 2015).

Metacognition is a key for a teacher to reflect their own work and the support they give to their students in instructional activities, particularly. Since teachers' Metacognitive Awareness is still an area of research that has been studied to a small extent, it is highly important to gain more detailed empirical research in the field. The aim of this study was to explore the metacognition of science teachers in northeastern Nigeria.

4.0 PURPOSE OF THE STUDY

The purpose of the study is as follows

a) To determine science teachers metacognitive awareness level in the North-East Nigeria
b) To determine the influence of science teachers metacognitive awareness level on their students' performance

5.0 RESEARCH QUESTION

The following research questions were answered at 0.05 level of significance

c) What is science teachers' metacognitive awareness level in North-East Nigeria?
d) What is the influence of science teachers' metacognitive awareness level on their students' performance?

6.0 RESEARCH HYPOTHESIS

HO1 There is no significant influence of the mean of science teachers' metacognitive awareness level on their students' Performance.

7.0 METHODOLOGY

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The study adopted a survey research design to determine science teachers' metacognitive awareness level and its effects their students' performance. The population for the study involved all secondary school science teachers and their students in North-Eastern Nigeria. A simple random sampling technique was used in sampling three states out of the six northeastern states of Nigeria. All secondary schools within the three-state capital metropolises were used for data collection. The purposive sampling technique was used in selecting science teachers that were involved (science teachers with science education qualifications). The instruments used for data collection were the Metacognitive Awareness Inventory (MAI)adapted from the study of Isil and Meltem (2016) to determine the metacognitive awareness levels of-service science teachers. This inventory is a 25-item scale and all of the items are rated on a 5-point Likert scale, ranging from 1'strongly disagreed' to 5 'strongly agreed', including eight sub-components (declarative knowledge, procedural knowledge, conditional knowledge, monitoring, planning, evaluation, debugging, information management), grouped under two main components (knowledge of cognition and regulation of cognition). In particular, declarative knowledge, procedural knowledge, conditional knowledge sub-components derived from the knowledge of cognition component, while monitoring, planning, evaluation, debugging, information management came within the regulation of cognition component. Cronbach's Alpha was utilized to find out the reliability of the inventory in the context of the research for internal consistency and was found to be 0.84. Science students' examination records taught by the teachers involved in the study were used to determine the influence of the in-service teacher metacognitive awareness level. Mean, Standard deviation, and Pearson product-moment coefficient were used for data analysis.

8.0 RESULT

Research Question 1

What is science teachers' metacognitive awareness level in North-East Nigeria?

Table I: Mean and Standard Deviation In-service Science Teachers Metacognitive Awareness level North East Nigeria

Statement	X	SD
I. **Declarative Knowledge**		
1. I am aware of the strength and weakness in my teaching	2.59	0.48
2. I know the important of skills to a good teacher	2.35	0.41
3. I have control over my teaching activities	2.40	0.54
4. I know what I am expected to teach	2.51	0.34
II. **Procedural Knowledge**		

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5. I try to use teaching techniques that work in the past 2.45 0.46

6. I have a specific reason for chosen each teaching techniques in my teaching 2.39 0.49

7. I am aware of the teaching techniques I used in my teaching 2.33 0.52

8. I use helpful teaching techniques automatically2.55 0.39

III. **Conditional Knowledge**

9. I use my strength to compensate for my weaknesses 3.100.30

10. I can motivate myself to teach when I really need to teach 2.580.35

11. I use different teaching techniques depending on the situation 2.450.50

12. I know when each teaching techniques I use will be most effective 2.570.31

IV. **Planning**

13. I pace myself while I am teaching in order to have enough time 2.11 0.56

14. I set my specific teaching goal before I start teaching 2.52 0.33

15. I ask myself questions about the teaching material I am going to use. 2.48 0.43

16. I organized my time to best accomplish my teaching goal. 3.00 0.32

V. Monitoring

17. I ask myself periodically if I meet my teaching goals while I am teaching 2.12 0.55

18. I assess how useful my teaching techniques are while teaching 2.57 0.36

19. I check regularly the extent to which my students comprehend the topic while I am teaching 2.43 0.45

20. I ask myself questions about how well I am doing while I am teaching 2.55 0.34

IV. Evaluation

21. I ask myself how well I accomplished my teaching goals once I am Finished 3.00 0.30

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22. I ask myself if I could have use different techniques after each teaching Experience	2.52	0.30
23. I find out if the assessment techniques I am using are appropriate	2.31	0.58
24. After teaching a point, I ask myself if I had taught it more effective Before	2.44	0.39
25. I ask myself if I have consideredall possible assessment techniques after teaching a point	3.10	0.29
Total	**2.54**	**0.41**

Table I,shows that, in-service science teachers' metacognitive awareness level is on the average with mean of 2.54 and standard deviation of 0.41. Considering the mean of 2.54, it is concluded that the cognitive knowledge and knowledge of the regulation of in-service teachers of Northeastern Nigeria is on the average.

Research Question 2

What is the influence of science teachers' metacognitive awareness level on their students' performance?

Table II: Mean and Standard Deviation of Science Teachers Metacognitive Level and their Students Performance.

Variables	N	X	SD
STMAL	408	2.54	0.37
SP	354	60.80	1.85

STMAL = Science Teachers Metacognitive Awareness Level, SP = Students Performance

Table II, shows that both the Science teacher metacognitive awareness level and students' performance are on the average, the mean of 2.54 and 60.80 respectively. Therefore, this means that students perform is based on their teachers' level of metacognition.

Research Hypothesis

Ho1There is no significant influence in the mean of science teachers' metacognitive awareness level and theirstudents' achievement.

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Table III: Influence of Science Teachers Metacognitive Awareness Level and Their Students Performance

STMAL	SP		
STMAL	Pearson Correlation	1	0.513
A	Sig. (2tailed)		0.000
	N	408	354
SP	Pearson Correlation	0.513	1
	Sig. (2tailed)	0.000	
	N	354	376

STMAL = Science Teachers Metacognitive Awareness Level

SP = Students Performance

Table III, indicates that, there is significant relationship between Science teachers' metacognitive awareness level and their students' achievement with 0.000 at 0.05 level of significance. Considering the above result it can be concluded that students' performance has high relationship with their teachers' metacognitive awareness level.

9.0 DISCURSION OF FINDINGS

The result indicates Average metacognitive awareness level in the part of science teacher and also has significant influence on their students. This corroborates with Young and Fry (2008), based on their research study where they investigated to reveal the relationship between metacognitive awareness and academic achievement in college students, found out that there are correlations between the MAI (Metacognitive Awareness Inventory) and cumulative GPA (Grade Point Average).It also supports the Seraphin, Philippoff, Kaupp and Vallin (2012) who suggest that teachers need to be supported in their metacognitive development for its reflection on students' outcome. This also agrees with Mai (2015) who states that teachers are the tools that regulate students' academic success.It is in support of Goos, Galbraith and Reenshaw (2000) stated that a failure in metacognitive skills ensures the corresponding failure in teachers thinking and problem solving.

10.0 CONCLUSION

Based on the findings, it was indicated that science teachers' metacognitive awareness is on the average, which significantly affect their students' performance. Therefore science teachers metacognitive awareness should be improved so as the students' performance will also be improved.

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11.0 RECOMMENDATION

Based on the result of the study, the following recommendations are made

i. Science teachers need to undergo further training on metacognition to update their skills in teaching effectively.
ii. During training, the importance of building up of teachers metacognitive awareness should be emphasized.
iii. School administrators should see to it that forums are organized for science teachers to acquire this necessary skill for effective teaching in classrooms.
iv. School administration should also help in the purchase of necessary materials, books etc., so that science teachers can use to enhance their awareness on different teaching skills.

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