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SECONDARY SCHOOL PHYSICS TEACHERS' AWARENESS AND USE OF META-COGNITIVE TEACHING STRATEGY IN TEACHING PHYSICS IN ENUGU STATE

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ABSTRACT

Secondary school Physics teachers' awareness and use of metacognitive teaching strategies in teaching in Enugu state was established. Two research questions and two null hypotheses tested at 0.05 level of significance guided the study. Descriptive survey design was employed in the conduct of the study. The population of the study involved 196 Physics teachers in the 291 government owned secondary schools in Enugu state, Nigeria. Simple random sampling technique specifically balloting with replacement was applied to obtain a sample of 105 Physics teachers from three education zones in the state involving 52 Experienced and 53 Beginning Physic teachers. The metacognitive teaching strategy questionnaire for Physics teachers (MTSQPT) was used as the instrument for data collection. The MTSQPT was validated by three experts. The coefficient of reliability was obtained using Cronbach Alpha method. The internal consistency of MTSQPT was found to be 0.87and 0.76 for sections I and II respectively. Statistical mean and standard deviation were used to answer the research questions, while multivariate analysis of variance (MANOVA) was used to test the null hypotheses. The findings showed that both the Beginning and Experience Physics teachers are aware of and use the metacognitive teaching strategy in teaching to a very high extent; there is no significant difference between the Beginning and Experienced Physics teachers' awareness and use of metacognitive teaching strategy in teaching. Recommendations were made among which are that Physics teachers should be encouraged to use MTS in teaching Physics in secondary schools, Governments at all level and other relevant bodies such as Post Primary Schools Management Board should sponsor Physics teachers to seminars, conferences, workshops and refresher courses on the use of MTS in teaching Physics and also the Government should mandate all Physics teachers to register with TRCN and possess their maximum education training.

Keywords: Meta-cognitive teaching strategy, Awareness, Physics

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Introduction

Science is an important tool for development and productivity in any nation. It is also important for every nation that wants to maintain its independence, sovereignty, self-reliance, ensure growth and have its head held high among civilized nations (Gabriel, 2018). This is because, science provides the basic tools of industrialization and economic development in the areas of communication, transportation, information, energy, pollution and waste management control among others. In Nigeria, the study of science is of great importance and a lot of emphasis has been laid on science education (the teaching and learning of sciences).

Science is the pursuit of systematic and ordered knowledge. Science Teachers Association of Nigeria (STAN, 2015) views science as a process of social activity in which people seek to discover and understand the natural world. Shaibu (2018) also defines science as some form of organized knowledge on which we can describe a sort of prescribed esoteric procedure from unraveling the nature. Anosike and Okigbo (2024) summarized these definitions by stating that science is a body of empirical, theoretical and practical knowledge about the world, accumulated through scientific methods, which emphasizes observation, experimentation and explanation of the real world phenomenon. For teaching and learning of science to be efficient and effective, a teacher should be involved.

Teachers are prime movers of any educational institution and they are professionals, who are important implementers of the subject curriculum. Abiri (2015) describes a teacher as a professional, who impacts knowledge, learning experience at his disposal, stimulates, guide, directs and facilities learners to acquire adequate mastery of the skills being impacted. Teachers create a positive learning environment in which the student is responsible for learning and understanding the concepts. In Nigeria according to Shaibu (2018), secondary school teachers are grouped into science teachers and art teachers, and the science subjects include Physics, chemistry, biology, agriculture, but in all, Physics is accepted as one of the bedrock of all science subject because many of the tools on which the scientific and technological advancement depends on are the direct products of Physics (Anosike and okigbo, 2024).

Physics deals with the study of laws that determine the structure of the universe with reference to matter and energy in the universe (Ike, 2014).It is a science subject that explains the fundamental constituents of the universe, the forces that exert on one another, man's daily activities and his interaction with the universe were also explained (Jegede and Adebayo, 2013). Physics is therefore one of the core science subjects since it studies the essence of natural phenomena and helps people understand the rapidly technological changing society (Zhaoyao, 2012). Wilbert (2017) defines Physics as a branch of science concerned with nature and properties of matter and energy. It is the study of matter and the movement of matter through space and time in the universe. Ivowi (2018) also defines Physics as that branch of science concerned with the study of matter and how it interacts with its energy through space and time. From these definitions and in the context of this work, Physics is the process of finding solutions to the fundamental challenges concerning human life based on the existence of phenomenon involving energy and matter by observation, measuring, experimenting and analyzing, predicting and drawing conclusion.

There have been a consistence decline in the academic achievements of secondary school Physics students in internal examination. This is becoming so worrisome that they might have massive failure in external examination like WASSCE, NECO and JAMB. This decline according to Omole (2015) might be caused by many factors like symmetrical nature of the subject, non-chalant attitude of students to classes, qualification of the teacher etc. but mostly on the teaching strategies employed by the teacher during instruction

Teaching strategies are means used by teachers to create a conducive learning environment and also specify the nature of the activity in which the teacher and learner will be involved during instructional delivery. According to Adeyemi (2018), it is primarily a description of learning objective oriented activities and the flow of information between the teacher and the learner. O,banon (2016) categorized teaching strategies into two approaches namely teacher centered approach and student centered approach.

Omole (2015) explained that teacher centered approach are grounded in behaviorism and include all teaching methods that sees teachers as possessor of knowledge. These methods as highlighted by Okoli (2016) includes lecture/expository, demonstration, discussion, recitation etc. Students centered approach according to Omole (2015) are grounded in constructivism and includes all the instructional methods that underscores teachers as decision maker and problem solvers but rather as a guide and facilitator in the learning process. Students centered approach portrays students as being in control of their own learning and as such learning is independent, collaborative, co-operative and competitive. Tharus (2017) emphasized that students centered method of instruction is in line with the National Policy in Education and metacognitive teaching strategies is among the students centered strategies of learning.

Meta-cognition is explained as thinking of what you are thinking. Onovughe, Adedipe and Temidayo (2021) defined meta-cognition as a level of thinking that involves active control over the process of thinking that is used in learning situations. According to Martinez (2016), meta-cognition is the monitoring and control of thought. Thus, Kuhn and Dean (2014) regard meta-cognition as awareness and management of one's own thought. Based on Kuhn and Dean's work, meta-cognition is what enables a learner who has been taught a particular strategy in a particular problem context to retrieve and use that same strategy in a similar context.

Meta-cognitive strategy refers to one's knowledge concerning one's own cognitive processes, hence, metacognitive learning strategy is what a teacher or learner arranged to establish interaction between the teacher, the students, and the subject matter, of any combination of these three dimensions (Vijaya and Jinto, 2014). Onovughe et al (202s1) further stated that planning the way or strategizing a learning task, monitoring comprehension, and evaluating the progress towards the completion of a task etc are skills that are meta-cognition in nature. Meta-cognitive activities involve necessary components for successful problem solving. Such components include Physics knowledge and experience, separating relevant from irrelevant information, and the ability to use a variety of strategies (Schneider and Artelt, 2013). Therefore, meta-cognitive teaching strategies are actions which go beyond purely cognitive devices and which provide learners to coordinate their own learning process (Begam, 2017).

Begam, (2017) further stated that, meta-cognitive teaching strategies are sequential processes that one uses to control cognitive activities, and to ensure that a cognitive goal is achieved. These processes help to regulate and oversee learning, and consist of planning and monitoring cognitive activities, as well as checking the outcomes of those activities. Research findings of some studies that employed meta-cognitive instructional strategies show that meta-cognitive teaching strategy enhances students' performance in various subjects. For instance, Xiying and Gang (2013) found out that students performed higher in English when taught using meta-cognitive strategies. Similarly, students' performance in Biology was enhanced and effective correlates of success in college anatomy and physiology when meta-cognitive approach was used (Okoza, Aluede and Owens-Sogolo, 2013).

The above evidence suggests that meta-cognitive teaching strategy enhances students' academic achievement. However, there are some strategies that make up the meta-cognitive teaching strategies. These are; Collaborative, Simulation, Modeling, Self-Regulation, Concept Mapping and Problem Solving (Okoza, Aluede and Owens-Sogolo 2013). There is need, therefore, to investigate whether Physics teachers are aware of metacognitive teaching strategy and if they are aware, how often do the use it in teaching Physics in Enugu state. Teaching using a meta-cognitive approach involves having students actively participate in the construction of their own knowledge, and is therefore an activity-based approach (Aurah, 2013).

Fafunwa (2000) opined that teachers could be male or female and that the effectiveness of a teacher is in determinant of the sex but highly depends on the teachers' qualification and years of teachers' experience. Experience in this context, according to Brown (2023) involves so many years of series of experiments, observation, modified initiatives, verifications, revalidation of facts, concepts and principles added in teaching. Physics teachers believe that the primary purpose of Physics education is to develop enlightened students that will understand the principle, unsymmetrical nature of the two disciplines (Physics and Mathematics), and foundations of Physics. It is a well-established fact that to attain this goal, an experienced teacher is required irrespective of the sex. The questions still remains, are Physics teachers aware of metacognitive teaching strategy and to what extent do they use it in teaching?

Purpose of Study

The aim of this study is to determine the secondary school Physics teachers' awareness and use of meta-cognitive teaching strategy in teaching Physics in Enugu state. Specifically, the research sought to:

1. Compare beginning and experience Physics teachers' extent of awareness of meta-cognitive teaching strategies in teaching Physics in Enugu state.
2. Find out the extent to which Physics teachers' use of meta-cognitive teaching strategies in teaching Physics based on their teaching experience in Enugu state..

Research Questions

The following research questions were formulated to guide the study.

1. What is the extent of beginning and experienced Physics teachers' awareness of metacognitive teaching strategies in teaching Physics in Enugu state?

2. What is the extent to which Physics teachers' use metacognitive teaching strategies in teaching Physics relates to teaching experience in Enugu state?

Hypotheses

The following null hypotheses guide the conduct of this study, which was tested at 0.05 levels of significance.

1. There is no significant difference between the mean rating of beginning and experienced Physics teachers on their extent of awareness of metacognitive teaching strategy in teaching Physics in Enugu state.
2. There is no significant difference between the mean rating of beginning and experienced Physics teachers on the extent of use of metacognitive teaching strategy in teaching Physics in Enugu state.

Research Method

The descriptive survey design was employed in the study. The study was conducted in Enugu state. The population of the study includes all the Physics teachers in the 291 government owned secondary schools in Enugu State. The total population of Physics teachers in the 291 government owned secondary schools is 196. The sample consist of 105 Physics teachers involving 52 Experienced and 53 Beginning Physic teachers drawn from three out of the six education zone in Enugu state using simple random sampling technique, specially, balloting with replacement. The instrument used for data collection is the Metacognitive Teaching Strategy for Physics Teachers (MTSPT). It is a 44-item questionnaire structured and adopted by the researcher to elicit responses from the participants. The instrument is in two parts, A and B. Part A is structured by the researcher to generate the respondents' personal data like age, qualification and years of teaching experience. Part B is also divided into two sections, I and II. Section I sought out information on the extent of Physics teachers' Awareness of metacognitive teaching strategy. This section is structured on a four (4) point rating scale of Fully Aware (FA), Moderately Aware (MA), Little Aware (LA), and Not Aware (NA). Section II sought out information on the extent of Physics teachers' use of metacognitive teaching strategy in teaching. It is also structured on a four (4) point rating scale of Very High Extent (VHE), High Extent (HE), Low Extent (LE) and, Very Low Extent (VLE). Section I and II are made up of 22 items each making a total of 44 items. For the face validation of the items in the questionnaire, the questionnaire was given to one lecturer in the Department of Educational Foundations, one senior lecturer in the Department of Science Education, both from the Faculty of Education, Nnamdi Azikiwe University, Awka and one experienced Physics teacher in a secondary school in Enugu state. These specialists validated the instrument in terms of grammatical adequacy and proper wording of the items, clarity of question to the research topics and appropriation and adequacy of the items in addressing the purpose and problem of the study. Based on their corrections and suggestions, amendments were made and the final instruments were produced. To ensure the reliability of the instrument administered to some Physics teachers in Anambra state. The researcher administered the instrument to 10 Physics teachers in government owned secondary schools in Anambra state twice at the interval of two weeks. The two sets of scores from the teachers' rating were recorded and cronbach

alpha correlation was employed to determine the estimate of stability of the items. The reliability index for section I is 0.87 while the reliability index of section II is 0.76. The researcher accepts the instrument to be reliable by these indices (Agu, 2015). For distributed of the instrument, the researcher trained two assistants to assist in the exercise. After the briefing, the researcher and the trained assistants separately moved to each of the schools in two weeks to administer the instrument and as well collect them immediately after the respondents might have attended to them. In this way, 105 copies of questionnaire was distributed and collected and this ensured 100% return rate. Mean and standard deviation were used to answer the research questions. The mean interpretation of the extent of the Physics teachers' awareness of metacognitive teaching strategies:

Mean score Interpretation
72.00 – 88.00 Fully aware
55.00 – 71.00 Moderately aware
39.00 – 54.00 Little aware
22.00 – 38.00 Not aware

The mean interpretation of the Physics teachers' extent of use of metacognitive teaching strategies: in teaching based on their teaching experience is represented as follows:

Mean score Interpretation
72.00 – 88.00 Very High extent
55.00 – 71.00 High extents
39.00 – 54.00 Low extents
22.00 – 38.00 Very Low extent

In testing the hypothesis MANOVA were used, if the calculated value is less than the critical value at 0.05 ($P<0.005$) alpha levels accept the null hypothesis or otherwise reject the null hypothesis.

Presentation of Results

Research Question 1: What is the extent of beginning and experienced Physics teachers' awareness of metacognitive teaching strategies in teaching Physics?

Table 1: mean rating of the extent of beginning and experienced Physics teachers' awareness of metacognitive teaching strategies in teaching Physics

	N(Beginnnig)=53			N(Experience)-52		
Item	**N**	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**
aware1	53	3.19	1.161	52	3.23	1.148
aware2	53	3.72	0.455	52	3.48	0.727
aware3	53	3.58	0.692	52	3.27	0.952
aware4	53	3.51	0.669	52	3.63	0.525
aware5	53	3.70	0.540	52	3.75	0.437
aware6	53	3.85	0.411	52	3.85	0.364
aware7	53	3.53	0.608	52	3.46	0.576
aware8	53	3.72	0.533	52	3.77	0.425
aware9	53	3.60	0.599	52	3.63	0.486
aware10	53	3.72	0.533	52	3.48	0.700
aware11	53	3.81	0.395	52	3.67	0.617
aware12	53	3.57	0.537	52	3.60	0.634
aware13	53	3.36	0.762	52	3.60	0.534
aware14	53	3.75	0.434	52	3.85	0.364
aware15	53	3.74	0.445	52	3.71	0.536
aware16	53	3.38	0.713	52	3.35	0.764
aware17	53	3.81	0.521	52	3.603.	0.534
aware18	53	3.70	0.540	52	3.60	0.534
aware19	53	3.45	0.722	52	3.63	0.525
aware20	53	3.66	0.649	52	3.58	0.667
aware21	53	3.74	0.486	52	3.48	0.671
aware22	53	3.55	0.667	52	3.62	0.491
Total awareness of ethics		79.6226	5.72184		78.8269	4.75568
Valid N (listwise)						

Presentation of data related to research question 1: The result on table 1 shows a total mean of 79.62, with a standard deviation of 5.72 for beginning Physics teachers' respondent and a total mean of 78.84 with a standard deviation of 4.76 for experienced Physics teachers' respondent. This shows that both beginning and experienced Physics teachers used for this study are aware of metacognitive teaching strategies for teaching Physics to a high extent.

Research Question 2: What is the extent of beginners and experienced Physics teachers' use of metacognitive teaching strategies in teaching Physics?

Table 2: mean rating on the extent of beginners and experienced Physics teachers' use of metacognitive teaching strategies in teaching Physics.

	N (Beginning)=53			N(Experienced)=52		
Item	**N**	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**
use1	53	2.79	1.116	52	2.65	1.170
use2	53	3.25	0,830	52	3.38	0.565
use3	53	3.11	1.068	52	2.92	1.100
use4	53	3.34	0.831	52	3.23	0.921
use5	53	3.43	0.844	52	3.52	0.727
use6	53	3.34	0.939	52	3.50	0.780
use7	53	3.21	0.927	52	3.50	0.781
use8	53	3.45	3.845	52	3.31	0.699
use9	53	3.38	0.860	52	3.46	0.866
use10	53	3.15	0.988	52	3.27	0.932
use11	53	3.25	0.830	52	3.38	0.908
use12	53	3.36	0.787	52	2.87	0.785
use13	53	3.43	0.821	52	3.33	0.789
use14	53	3.49	0.869	52	3.35	0.653
use15	53	3.47	0.932	52	3.65	0.728
use16	53	3.00	1.038	52	3.50	0.874
use17	53	3.40	0.862	52	2.98	0.728
use18	53	3.42	0.887	52	3.50	0.753
use19	53	3.36	0.834	52	3.46	0.754
use20	53	3.26	0.984	52	3.48	0.795
use21	53	3.21	0.906	52	3.27	0.814
use22	53	3.21	0.948	52	3.35	0.848
Total use of ethics		72.3019	14.00355		72.7885	9.93180
Valid N (listwise)						

Presentation of data related to research question 2

The result of table 2 shows a total mean of 72.30 with a standard deviation of 14.00 for beginning Physics teacher respondent and the total mean of 72.79 with a standard deviation of 9.93 for experience Physics teachers respondent. This shows that both the beginning and the experienced Physics teacher respondent use metacognitive teaching strategy to a very high extent.

Table 3: summary of two ways multivariate analysis of variance (MANOVA) of mean responses of beginning and experienced Physics teachers on their extent of awareness and use of metacognitive teaching strategy in teaching in Enugu state

TEST OF BETWEEN – SUBJECT EFFECTS

SOURCE	DEPENDENT VARIABLE	TYPE III SUM OF SQUARES	DF	MEAN SQUARE	F	SIG.
Sex	Awareness and use of metacognitive teaching strategy	9.916 231.769	1	9.916 231.769	0.194 1.254	0.660 0.265
Sex*experience	Awareness and use of metacognitive teaching strategy	2.865 278.530	1	2.865 278.530	0.056 1.507	0.813 0.222
Error	Awareness and use of metacognitive teaching strategy	5149.287 18661.657	101 101	50.983 184.769		
Total	Awareness and use of metacognitive teaching strategy	635404.000 559605.000	105 105			
Corrected Total	Awareness and use of metacognitive teaching strategy	5290.133 19166.057	104 104			

Hypothesis 1: There is no significant difference between the mean rating of beginning and experienced Physics teachers on their extent of awareness of metacognitive teaching strategy in teaching.

From table 3 the significant level is 0.660 this means that there was no significant difference between the mean rating of beginning and experienced Physics teachers on their extent of awareness of metacognitive teaching strategy in teaching. The null hypothesis is therefore accepted at 0.05 alpha level. Hence, this proves that the beginning and experienced Physics teachers have almost equal awareness of metacognitive teaching strategy for teaching in Enugu state.

Hypothesis 2: There is no significant difference between the mean rating of beginning and experienced Physics teachers on the extent of use of metacognitive teaching strategy in teaching.

From table 3, the significant level is 0.265. This means that there is no significant difference between the mean rating of beginning and experienced physics teachers on their extent of use of metacognitive teaching strategy in teaching. The hypothesis is therefore accepted at 0.05 alpha levels. Therefore, the hypothesis shows that there is no much difference in beginning and experienced Physics teachers' use of metacognitive teaching strategy in teaching in Enugu state.

Discussion of Findings

Results of the study revealed that both beginning and experienced Physics teachers used for this study are aware of metacognitive teaching strategies for teaching Physics. The results also showed that that both the beginning and the

experienced Physics teacher respondent use metacognitive teaching strategy to a very high extent.

Furthermore, the study also proved that there was no significant difference between the mean rating of beginning and experienced Physics teachers on their extent of awareness and use of metacognitive teaching strategy in teaching. Furthermore, this result corroborates the findings of Farahani and Nejad (2018), who found that the metacognitive teaching strategy did not discriminate between the experiences in terms of how they learned to speak. This results also corroborates the findings of Emenike (2017), who stated that while teaching Physics using a metacognitive teaching strategy, both beginning and experienced Physics teachers had similar levels of success. The fact that a metacognitive approach to education guarantees success and effective teaching and learning process is proof of this claim, and this holds true regardless of the experience of the teacher.

Conclusion

On a more important note, teachers should understand the importance of the functioning role of metacognition in teaching and learning. Consequently, this will enable the teachers to know when and how to utilize the strategy while teaching. Apart from that, the recommended instruction strategies that urge students to be strategic thinkers should be adopted in helping them to focus on how they process information. From our experience of teaching, many Physics learners do not like Physics because they regard it as too difficult, and they cannot see the relevance of Physics for their everyday or future lives. Learners also regularly enquire about effective study methods in Physics. The use of metacognitive teaching strategies could address these concerns as teachers, by valuing learners' ideas and feelings (modelling), could assist in improving learners' attitudes towards Physics. Learner self-regulation could also be improved by the keeping of a reflective journal. By assigning real-life problems (problem solving activities), teachers have the opportunity to show the relevance of Physics in learners' every day and future lives. The metacognitive strategies identified in this study could serve as a guide in ensuring effective teaching and assisting learners to study and learn Physics effectively. These can only be achieved if the Physics teachers are aware of metacognitive teaching strategies and as well use it effectively during instruction.

Recommendations

1. Physics teachers should be encouraged to use MTS in teaching Physics in secondary schools.
2. Governments at all level and other relevant bodies such as Post Primary Schools Management Board should sponsor Physics teachers to seminars, conferences, workshops and refresher courses on the use of MTS in teaching Physics.
3. 3 Government should mandate all Physics teachers to register with TRCN and possess their maximum education training.

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