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Attitude of Science and Technology Education Lecturers and Students Towards Using Metacognitive Strategies in Colleges of Education in North-East Nigeria

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Abstract

The study investigated the attitude of lecturers and students of Science Technology Education and Mathematics (STEM) towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria. One purpose was identified, one research question answered and one null hypothesis tested. The study employed descriptive survey research design in which a 16-item instrument, designed by the researchers, was used in collecting data from a sample of 138 respondents were randomly selected, made up of 56 lecturers and 82 students, drawn from 10 Colleges of Education in the North-East Zone. The instrument was validated by two experts in Science Education, drawn from Department of Education, University of Maiduguri. The validated copy was pilot tested on 25 students and 10 lecturers of Science Education programme from Sa'adatu Rimi College of Education, Kano, an institution outside the study area. Test re-test method was used to obtain the reliability of the instrument, using the Pearson Product Moment Correlation Coefficient (r) which stood at 0.87. Mean and standard deviation were used in analyzing and answering the research question. The null hypothesis was tested at 0.05 level of significance using the z-test. The study found that students of Science Technology Education and Mathematics (STEM) in Colleges of Education in the North-East Zone of Nigeria had a positive attitude towards metacognitive learning strategies. The study also found that there was no significant difference between the mean scores of the responses of lecturers and students on the students' attitude towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria. It recommended among others, that Students of STEM in Colleges of Education in North-East Zone should continuously develop positive attitude towards metacognitive learning strategies which have the tendency to improve their performances, and methods should be put in place by lecturers and management of the Colleges of Education to design programmes, activities and schedules which are able to arouse students' interest in metacognition and as well sustain such interest.

Keywords: Attitude, Science Technology Engineering and Mathematics, Metacognition, Metacognitive Learning Strategies

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Introduction

Education occupies a central place in the development of every nation, hence there is no dynamic society that can do without it. Every nation therefore aspires, through the provision of appropriate educational policies and resources, to build the type of tertiary educational institutions required for uplifting the youth within its society (Black & William, 1998). One type of education which lays emphasis on the acquisition of skills for functional living is science education, which according to FGN (2014) in National Policy on Education document, is that education given to individuals which equips them with functional skills and knowledge that make them contribute to national development.

One way of transmitting Science Technology Engineering and Mathematics (STEM) knowledge and skills is through problem solving. This can be achieved by what is generally called metacognition. The idea of metacognition was long propounded since the days of Plato (Georghiades, 2004). During the days of Aristotle, mind used a different power above and beyond seeing and hearing and thus laid the foundations for thinking about metacognition long before (Sandi-Urena, 2008). According to Steinbach (2008), Piaget was the one who first

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mentioned "knowing the knowing and thinking the thinking" in the early years of cognitive development and personal information epistemology. However, Akturk and Sahin (2011) held that John Flavell is known to be the first scholar who used the concept of metacognition, a term he derived from the term metamemory.

Metacognition is a term which, according to Ormrod (2004), refers to what human beings know about their cognitive processes and how they use these processes in order to learn and remember. It is defined as the activity of monitoring and controlling one's cognition (Young & Fry, 2008). Young and Fry added that metacognitive knowledge can be described as what we know about our own cognitive processes.

Although metacognition has been viewed in different ways by writers on the subject, a common point in the definitions deals with monitoring strategies for learning process (Bonner, 1988). Researchers like Paris and Winogard (1990) blended two different approaches that emphasize the importance of cognitive states and processes and the control of the executable aspect of metacognition in a single definition. This definition undoubtedly involves an individual's planning of his information about his own and others' cognitive processes before they will fulfill their task, observing their thinking, learning and understanding while performing a task, controlling and regulating their thinking by making arrangements on site and evaluating after they have completed their task (Scoot, 2008). This way, the learners are able to record their progress as they develop other ways through the thinking process to improve on lost grounds.

In this study therefore, metacognition is used to refer to the process of higher order thinking in learning (STEM); it is an approach that helps learners to be able to monitor, assess, evaluate and manage their learning activities or tasks in Science Education. These tasks are not left on the learners alone but through the collaborative efforts of the teachers who help the learners develop these approaches. Therefore, according to Ekpenyong (2008), STEM as a programme plays a vital role in meeting the technological aspiration of Nigeria as a nation through the production of skilled workforce.

According to Medina (2008), metacognition is important to every profession. In education, metacognition guides our learning strategies in the learning process. If learners know what they know and do not know that they don't know, they can focus on acquiring the knowledge they are lacking. However, at the moment there are certain difficulties experienced in the transmission of knowledge and skills through the process of metacognition. One of such difficulties is the attitude of students towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria. According to Shannon (2008), students develop nonchalant attitude towards metacognition, arising mainly from their lack of knowledge (not being aware) of metacognitive learning strategies. Such students lack understanding of an approach to self-directed learning. Consequently, they face difficulties in understanding cognitive tasks and the nature of what is required to complete them in some science practical activities. In the end, they are not able to apply metacognitive learning strategies to improve their thinking ability towards a better performance in STEM. If the trend is not investigated but left to continue, students will not be able to acquire the necessary skills that will make them to be useful members of the society. This undoubtedly will derail the effort of a nation such as Nigeria towards scientific and technological development. There is therefore, reasonable background to address this problem.

Purpose of the Study

To examine the attitude of lecturers and students of Science Technology Engineering and Mathematics towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria.

Research Question

What is the attitude of lecturers and students of Science Technology Engineering and Mathematics towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria?

Hypothesis

There is no significant difference between the mean scores of the responses of lecturers and students on the attitude of students of Science

Technology Engineering and Mathematics towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria.

Literature Review

The knowledge of metacognitive learning strategies (awareness) cannot be overemphasized and it is one of the learning strategies that can develop positive attitude towards the students. Another challenge in using metacognition in Colleges of Education deals with the attitude of students towards metacognitive learning strategies. According to Shannon (2008), because students are not aware of metacognitive learning strategies, they develop a nonchalant attitude towards them. Such students lack understanding of an approach to self-directed learning. Consequently, they face difficulties in understanding cognitive tasks and the nature of what is required to complete them. To deal with this, Schunk and Zimmerman (2004) stressed that there is need to help the students to develop a sense of awareness of their learning process through self-assessment approach as this will also help them to be aware of what they know and what they ought to know.

Even if students are aware of metacognitive learning strategies, one critical challenge lies in identifying which metacognitive learning strategies are essential in facilitating learning. Students are however, unable to achieve this because of the poor attitude they have towards them. According to Darling-Hammand, et'al (2008) learners are expected to self-manage their learning process. Since they do not have any positive attitude towards them, the authors held that the students need to be guided by the teacher such as in the following ways; (a) it helps students to understand what kinds of information they might need to successfully solve a problem; (b) evaluating work – reviewing of work done to determine where their strengths and weaknesses lie within the work or task; (c) questioning by the teacher – the teacher asks the students questions as they carry out their tasks; (d) self-assessing – students reflect on their learning and determine how well they have learned some things, among others. By appropriately guiding the students, their interest in metacognitive study is aroused and they are able to develop positive attitude towards it.

There are certain factors that underlie independent learning. Anderson et'al (2003) included a number of metacognitive and self-assessment skills in their works in which they considered essential factors that deal with independent learning. These factors are ability to speak about one's own and other's behavior, monitor progress and seek help appropriately, negotiate when and how to carry out tasks, and being aware of the feelings of others. Others factors are awareness of one's own strengths and weaknesses, initiating activities, finding one's own resources without adult help, developing one's own ways of carrying out tasks and planning one's own tasks, targets and goals. All these are however, possible only when students develop positive attitude towards them.

Measurement of metacognition is naturally difficult because metacognition is an implicit behavior. Metacognition is not internal process only; on the contrary, individuals in many instances, are not aware of these processes. Sandi-Urena (2008) defined methods of measuring metacognition, via the temporary relationships of the method of measurement concerning the implementation of a task, as probable if it was implemented before the task, simultaneous if it was implemented during the task and retrospective if it was implemented after the task. Measurement tools that are used to measure metacognition can be investigated in two categories, namely reports based on an individual's own telling (questionnaires and interviews) and objective behavior measurements (i.e. systemic observation and think aloud protocols). The method of measuring metacognition, on the other hand, can be determined according to the type of the measurement tool that was used to measure metacognition.

Dike, et al (2017) identified three categories of metacognitive knowledge. They referred to these categories as the person, task and strategy. The authors argued that a metacognitive knowledge individual refers to one involved in the cognitive process. Task metacognitive knowledge refers to information, skills, and competencies available to a person. The strategy metacognitive knowledge category includes

knowledge of effective strategies that can be acquired in achieving various goals and in various sorts of cognitive undertakings (Rahman, 2011). These categories affect to a large extent an individual's pursuit for knowledge.

Metacognitive regulation involves setting goals and planning; monitoring and controlling learning; and evaluating one's own regulation (assessing results and strategies used). Those strategies, according to Novak (1987), empower the learners to take charge of their own learning in a very meaningful manner. They are skills that the teacher and the learners would need to use to achieve desired goals. In essence, learners use the strategies to regulate their cognitive process.

Many strategies have been identified by various researchers. Ashman and Conway (1997) reported that various techniques can be used to improve metacognition and the techniques included direct explanation, scaffolded instruction, cognitive coaching and cooperative learning. However, Cullen (2013) argued that metacognition can also affect learners negatively and hence, has the tendency to cause students develop a nonchalant attitude towards it. For instance, metacognition affects self-esteem of students. Ideally, poor metacognition makes students unable to develop proper self-esteem. Students with poor self-esteem normally lack the drive and taste for the art of planning, assessing, and evaluating their learning skills. This is why metacognitive strategies become difficult to be applied to students who lack good self-esteem. On the other hand, metacognitive strategies cannot work for students who lack proper reading and comprehension skills (Kagan, 2013). It requires students who are capable of understanding the instructions and demands of the tasks given (Cohen, 2014). And this calls for students to develop positive attitude towards the trend.

Methodology

The study adopted descriptive survey research design. A sample of 138 respondents were randomly selected in science, technology, education and mathematics departments, made up of 56 lecturers and 82 students, drawn from 10 Colleges of Education in North-East Zone of Nigeria. The States are Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe States. A 16-item instrument, designed by the researchers, was used to collect data. The instrument was validated by two experts in Science Education from Department of Education, University of Maiduguri. The validated copy was trial tested on 25 students and 10 lecturers of STEM from Sa'adatu Rimi College of Education, Kano, an institution outside the study area. Test re-test method was used to obtain reliability of the instrument, using the Pearson Product Correlation Coefficient (r) which stood at 0.87.

The instrument was rated on a 5-point scale as follows:

Very Positive (VP)	-	5 points
Positive	-	4 points
Moderately Positive (MP)	-	3 points
Negative (N)	-	2 points
Very Negative (VN)	-	1 point

Both groups of participants were required to respond to all the items in the questionnaire. Mean and standard deviation were employed to analyze the data for answering the research question. The z-test was used to test the hypothesis at 0.05 level of significance. True limits of real numbers were used to take decision in which mean ratings of 3.50 and above were rated as "Aware"; mean ratings of between 2.50-3.49 were considered "Moderately Aware". Similarly, mean ratings below 2.50 were taken as "Unaware". For the hypothesis, decision was: Reject the null hypothesis if z-calculated is greater than z-critical. If, however, the contrary is the case, uphold the null hypothesis.

Analysis and Results

Research Question: What is the attitude of lecturers and students of Science Technology Engineering and Mathematics Education towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria?

The data presented in Table 1 were used to answer this research question.

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Table 1: Responses of Lecturers and Students on the Attitude of lecturers and Students of Science Technology Engineering and Mathematics Education towards Metacognitive Learning Strategies in Colleges of Education in North-East Zone of Nigeria.

SN	Items	$\bar{x}_L$	δ_L	$\bar{x}_S$	δ_S	$\bar{x}_G$	Remarks
1	Self-motivation towards motivation of process skills.	4.00	0.87	4.38	0.69	4.23	Positive
2	Taking responsibility for learning to conduct laboratory practical.	3.93	0.71	4.09	0.79	4.03	Positive
3	Maintenance of independence in carrying out laboratory work.	3.77	0.81	3.66	0.97	3.70	Positive
4	Initiating self-correction in recording of results.	3.75	0.79	3.94	0.98	3.86	Positive
5	Monitoring one's own learning objectives.	3.68	0.83	3.72	0.99	3.70	Positive
6	Evaluating one's own learning volumetric analysis.	3.71	0.91	3.92	1.06	4.07	Positive
7	Ability to make informed choices of laboratory glass wares.	3.78	0.80	3.95	0.90	3.88	Positive
8	Seeking help appropriately when using laboratory equipment.	3.95	0.84	4.07	0.86	4.02	Positive
9	Negotiating on how to carry out tasks of laboratory investigation.	3.68	0.79	3.86	0.96	3.79	Positive
10	Taking cognizance of other learners' feelings while in taking readings.	3.57	0.74	3.56	1.04	3.56	Positive
11	Development of learning beliefs.	3.57	1.01	3.66	1.04	3.62	Positive
12	Linking prior knowledge with current knowledge (the "know" strategy).	3.55	0.78	3.86	0.99	3.73	Positive
13	Developing interest in learning (the "want" strategy).	3.62	0.95	3.85	0.94	3.76	Positive
14	Reflecting on what has been learnt about a topic (the "learnt" strategy).	3.68	0.85	3.92	1.03	3.82	Positive
15	Planning one's own learning in preparation for exams.	3.64	0.84	3.94	1.02	3.82	Positive
16	Reviewing examinations questions on practical.	3.77	0.97	4.00	0.99	3.90	Positive
	Grand Mean Scores	**3.37**		**3.90**		**3.84**	**Positive**

Key:
n_L = Number of Lecturers
n_S = Number of Students
$\bar{x}_L$ = Mean Score of Lecturers
$\bar{x}_S$ = Mean Score of Students
δ_L = Standard Deviation for Lecturers
δ_S = Standard Deviation for Students
$\bar{x}_G$ = Item grand mean score for both lecturers and students

Table 1 were data on the mean and standard deviation scores of the responses of lecturers and students on the level of students' attitude towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria. The mean scores of the respondents ranged between 3.55 and 4.38, of the 16 items on the table. The standard deviation scores of the respondents ranged between 0.69 and 1.06. These deviation scores showed that the respondents' scores were closer to the mean, indicating that they varied more closely in opinion regarding students' attitudes towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria. The grand mean scores for both groups of

respondents stood at 3.84. This result shows that students' attitude towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria was positive.

Test of Hypothesis

There is no significant difference between the mean scores of the responses of lecturers and students on the attitude of students of Science Technology Engineering and Mathematics towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria.

Table 2: z-test of Differences Between the Mean Scores of Respondents on the Attitude of lecturers and Students on Metacognitive Learning Strategies in Colleges of Education in North-East Zone of Nigeria.

Respondent category	Mean	SD	N	df	SE	z-cal	z-cri	Decision
Lecturers	3.73	0.14	56	136	0.02	0.00	1.96	Uphold
Students	3.90	0.20	82					

The data in Table 2 shows the result obtained when the hypothesis was tested at 0.05 level of statistical significance. The table shows that at degree of freedom (df) 136, z-calculated (z-cal) is 0.00 as against z-critical (z-crit) of 1.96. From this result, since z-cal is lower than z-crit, the null hypothesis is upheld. Therefore, there is no significant difference existing between the mean scores of the responses of lecturers and students on the students' attitude towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria.

Findings of the Study

The analysis of the results has yielded the following findings:

1. The attitude of lecturers and students of science technology education towards metacognitive learning strategies in Colleges of Education in North-East Nigeria was positive.
2. The learning strategies that lecturers and students of science education have positive attitude towards them include; reviewing examination questions on STEM practicals, initiating self-correction in process, seeking help appropriately when using laboratory equipment, taking responsibility for carrying out laboratory activities, monitoring one's own learning objectives, evaluating one's own learning pattern of STEM practical work, linking prior knowledge with current knowledge (the "know") strategy, developing interest in learning (the "want") strategy, reflecting on what has been learnt about a topic (the "learnt") strategy.
3. There was no significant difference existing between the mean scores of the responses of lecturers and students on students' attitude towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria.

Discussion of Findings

The study found that students had a positive attitude towards metacognitive learning strategies. This finding is supported by Dike, et al (2017) whose work demonstrated students' positive attitude towards metacognitive learning strategies which was able to improve their performance. The authors' study found that students taught with thinking-aloud metacognitive strategies performed better in chemistry achievement test followed by self-assessment metacognitive strategy than the conventional strategy. Consequently, the study concluded that metacognitive teaching strategy such as thinking-aloud and self-assessment, if well put to use by teachers in the instructional process, could significantly improve the performance of students. This is however, achievable when students develop positive attitude towards the metacognitive learning strategies.

The finding of Abdellah (2014) which supports this work does not only demonstrate the relationship between metacognitive awareness and academic achievement, and its relation to teaching performance of pre-service female teachers in Ajman College in the United Arab Emirates, but also the

attitude of students and teachers towards the use of metacognitive learning strategies in teaching. The conscious use of the Metacognitive Awareness Inventory (MAI) and Teaching Performance Checklist, and the positive attitude devoted to the use of metacognitive learning strategies discovered not only the importance of metacognitive teaching strategies but recommended the use of metacognitive skills which could improve both teachers' and students' performance.

The finding of the study is further supported by Sanad (2014) who held that students who demonstrate a wide range of metacognitive skills (adopting positive attitude to metacognitive learning strategies) perform better in examinations and are able to complete their work more efficiently. Such students are self-regulated learners who make use of the "right instruments" and modify learning strategies and skills based on their awareness of effectiveness. Students who have a high level of metacognitive knowledge and skill identify difficulties to learning early enough and are able to make effort to change strategies to ensure goal attainment.

The study finds support with the work of Darling-Hammand, et al (2008). According to the authors, learners are required to self-manage their learning processes. However, since they do not have any positive attitude towards them, the authors argued that the students need to be guided by the teacher such as in the following ways; (a) predicting outcomes- helps students to understand what kinds of information they might need to successfully solve a problem; (b) evaluating work – reviewing of work done to determine where their strengths and weaknesses lie within the work or task; (c) questioning by the teacher – the teacher asks the students questions as they carry out their tasks; (d) self-assessing – students reflect on their learning and determine how well they have learned some things, among others. This undoubtedly will enable the students to be on the alert about metacognitive learning strategies and hence, motivates them to develop positive attitude to the strategies.

The finding of the study runs contrary to the position of Shannon (2008) which showed that because students are not aware of metacognitive learning strategies, they develop a nonchalant attitude towards them. Such students lack understanding of an approach to self-directed learning. Consequently, they face difficulties in understanding cognitive tasks and the nature of what is required to complete them. To deal with this, Schunk and Zimmerman (2004) stressed that there is need to help the students to develop a sense of awareness of their learning process through self-assessment approach as this will also help them to be aware of what they know and what they ought to know. This will ultimately assist the students in developing a positive attitude towards metacognitive learning strategies.

The finding of the study is also supported by (Karpicke & Blunt, 2011) in which examinations themselves can be a metacognitive method of teaching and learning. Reviewing an examination with learners after grades are released can be a powerful way to help them start thinking about their thought processes, especially during the examinations. Such reviews can take place in a group setting with the entire class or during a one-on-one or small group interaction with learners. Buttressing this, Medina (2008) argued that reviewing an examination before it is taken can help learners assess their learning strategies and adjust accordingly. The author stressed that this positive attitude demonstrated when doing an examination review a couple of days before the examination still gives learners time to change their method of study and enhance weak areas.

The study also found that there was no significant difference between the mean scores of the responses of lecturers and students on students' attitudes towards metacognitive learning strategies in STEM in Colleges of Education in North-East Zone of Nigeria. This finding agrees with Schraw and Dennison's (1994) work which found that students' knowledge of cognition was able to correspond to what they knew about themselves, strategies, and the conditions under which those strategies were most useful, all of which were a product of their positive attitude towards them. The Schraw and Dennison's study also found that regulation of cognition corresponded to knowledge about ways that students undertook their plan, implement strategies, monitor, correct comprehension errors, and evaluate their learning. These factors also

strongly correlated, suggesting that knowledge and regulation worked in unison to help students to self-regulate.

Conclusion

The study investigated the attitude of lecturers and students of STEM towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria. From the analysis of the results, the study found the basis to make the following conclusion. Lecturers and Students of STEM in Colleges of Education in North-East Zone of Nigeria had a positive attitude towards metacognitive leaning strategies. The study also concluded that since no significant difference existed between the mean scores of the responses of lecturers and students on the students' attitude towards metacognitive learning strategies in Colleges of Education in North-East Zone of Nigeria, this clearly demonstrated the agreement in opinions between the two respondents and was a sign that metacognitive studies, if vigorously pursued, would improve students' thinking processes towards science oriented courses which could lead a nation such as Nigeria to achieving scientific and technological development.

Recommendations

Based on the study's findings and conclusion the study recommended that:

1. Science Technology Engineering and Mathematics students in Colleges of Education in North-East Zone of Nigeria should continuously develop positive attitudes toward metacognitive learning strategies which have the tendency of improving their performances.
2. Lecturers teaching in the Colleges of Education in the study area need to continuously assist students in the acquisition of metacognitive knowledge and skills.
3. Methods need to be put in place by lecturers and administrators of the tertiary institutions to design programmes, activities and schedules which are able to arouse students' interest in metacognition and as well sustain such interest.
4. Lecturers need to adequately and properly monitor students' metacognitive skills with a view to appropriately assisting them.

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