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Relationship Between Metacognition, Attitude And Academic Achievement Of Secondary School Chemistry Students In Port Harcourt, Rivers State.

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Abstract: *The study investigated the relationship among chemistry students' metacognition, attitude and academic achievement in secondary schools in Port Harcourt Local Government Area, Rivers State, Nigeria. A sample of 600 students in their intact classes from eight randomly selected coeducational senior secondary schools participated in the study. The study adopted correlational design, and utilized two research instruments [Metacognitive Awareness Inventory, MAI developed by Schraw & Dennison (1994) and Chemistry Students' Attitude Probe, CSAP developed by the researchers] to collect data. Data collected were analyzed using Pearson Product Moment Correlation, and stepwise multiple regression analysis. Results showed that both metacognition and attitude correlate significantly with academic achievement. However, attitude strongly predicts academic achievement more than metacognition.*

Keywords: *Metacognition, Attitude, Academic Achievement, Secondary School Chemistry*

I. Introduction

With the rapid pace of scientific and technological advancement couple with the globalization of science learning, science education in Nigeria is now a compulsory component of the National policy in Education (FRN, 2004). This is basically meant to promote scientific literacy- the central goal of science education. In addition to ensuring scientific literacy of the citizenry for a useful living in the society, science education at the primary and secondary school levels is aimed at preparing the individual for a higher science education.

Globally, the major goal of modern (21^{St} century) education is not only to enrich students with enormous amount of knowledge/facts in a given field of study, but also to groom the students to acquire self-regulatory skills required for them to become self-regulated learners to achieve academic success while in school as well as up-dating their knowledge and educating themselves in different fields even after leaving school. To Wolters (2003) self-regulated learners "… have the cognitive and metacogntive abilities as well as motivational beliefs and attitude required to understand, monitor and direct their own learning" Wolters (2003), Boekaerts & Corno (2005), among others argue that for any student to learn and achieve academic success the student must be actively engaged in the learning process, and be able to plan, monitor, regulate and control his/her cognitive processes as well as attitudes and behaviours. Meaning that a student must have and exhibit self-regulation of cognition and behaviour (i.e. the skills and wills) for him/her to effectively learn and perform very well in any school subject. By this conception, it is evident that the learner is the most determining factor of any learning activity since it is the learner that actually participates in the learning process and it is in the learner that learning takes place especially when he/she is metacognitively and emotionally ready to learn. Therefore, learners of science need to possess high metacognitive ability and the right attitude (or frame of mind) towards science to be able to engage actively in science learning and achieve success as well. It is against this background that the present study sought to examine the relationship between students' metacognition, attitude and academic achievement in chemistry.

II. Literature Review

Students' metacognition and academic achievement

Metacognition which literally means "thinking about thinking" (Hunt, 2006) or "cognition about cognition" came to light as an important cognitive or mental activity for solving problem when psychologists started to investigate into children's intelligence, how children learn, and involve in problem solving. The concept of metacognition entered the field of cognitive psychology in the 1970s when an American developmental psychologist, John Flavell (1976) recorded as the foundation researcher in metacognition, first formerly used the term in his article titled "metacognition aspect of problem solving". Later on, another

developmental psychologist, Ann Brown (1978) also used the term in a work titled "Knowing when, where and how to remember: A problem of metacognition". Flavell (1976) describe metacognition in these words:

In any kind of cognitive transaction with the human or non-human environment, a variety of information processing activities may go on. Metacognition refers, among other things, to the active monitoring and consequent regulation and orchestration of these processes, in relation to the cognitive objects or data on which they bear, usually in the service of some concrete goals or objective. J. H. Flavell; (1976:232).

In an attempt to elucidate the different components of metacognition and their interactions or relationship, Flavell (1979) and Brown (1987), proposed different models of metacognition. Flavell (1979), in his article title "Metacognition and Cognitive Monitoring" proposed a formal model of metacognition. His model encompasses four components: metacognitive knowledge, metacognitive experiences, tasks or goals, and strategies, while Brown's (1987) model of metacognition categorizes metacognition into two major components: Knowledge of cognition and Regulation of cognition.

One striking feature or assumption of the above theories and models of metacognition 1is that, metacognition consists of two basic but mutually related components or processes, viz: metacognitive knowledge (i.e. knowledge of cognition) and Metacognitive regulation (i.e. regulation of cognition), both occurring simultaneously (Metallidou,2009; Sungur, 2007 cited in Ozsoy & Ataman, 2009; Veeman, Van Hout-Wolters & Afflerback, 2006; Otani & Widner,2005; Schraw & Sperling-Dennison,1994; Flavell, 1987; Brown, 1987).

Metacognitive knowledge (also known as metacognitive awareness) is described as knowledge about cognition. It entails what one knows about himself, his cognitive processes, skills and strategies as well as when and how to effectively use the skills and strategies as he learns. This component of metacognition involves three subcomponents namely; *Declarative knowledge, Procedural Knowledge and Conditional Knowledge* (Brunning, Schraw, Norby & Ronning, 2004).

On the other hand metacognitive regulation (also known as regulation of cognition) refers to ones knowledge of a number of skills and activities or processes that promote the regulation or control of his thinking and learning. It connotes the ability to use metacognitive knowledge strategically in order to attain cognitive objectives (Coutinho, 2007), and consists of three essential processes or activities- *Planning, Monitoring and Evaluation* (Veenman et al, 2006).

In the view of Winne and Perry (as cited in Annevirta & Vauras, 2006:198), metacognition is the knowledge that learners have concerning their general academic strengths and weaknesses and of the cognitive resources they can apply to meet the demands of particular tasks, as well as their knowledge and skills relating to how to regulate their engagement in tasks so as to maximize learning process and outcomes.

Though Metacognition has been defined in several ways, it can be regarded as a derivative of two words- "meta" meaning "beyond or at a higher level" and "cognition" meaning "the process of knowing, understanding and learning something'' (Pearson Education Limited, 2003). Metacognition, therefore, is the higher intellectual ability of an individual to plan, reflect upon, monitor, understand and control his/her learning. It is a process involving ones awareness and regulation or control of him/herself (as a learner), the learning style and study habit as well as several other activities involved in his/her own learning so as to attain the set goal(s).

Metacognition has been reported to have influence on academic achievement. Some researchers contend that metacognition correlates significantly with students' academic performance or achievement (Bogdanović, Obadović, Cvjetićanin, Segedinac & Budić, 2015; Narang & Saini, 2013; Rahman, Jumani, Chandy, Christi, & Abbasi, 2010; Schraw & Sperling-Dennison, 1994; Young & Fry, 2008; Nietfeld, Cao & Osborne,2005; Everson & Tobias, 1998; Pintrich & DeGroot, 1990; while others view that explicit metacognitve training can enhance students' metacognition (Darlinng-Hammond, Austin, Cheung & Martin, 2008; Hartman, 2001 cited in Erskine, 2009; Veeman, Hout-Wolters & Afflerbach,2006) and as well promote students' academic achievement (Achufusi & Mgbemena, 2013; Nbina, 2012; Nzewi & Ibeneme, 2011; Ibe, 2009). They believe that students, who possess metacognitive knowledge and demonstrate a wide range of metacognitive skills tend to be more successful as they can self-regulate their learning, retain information longer, and perform better.

Other researchers found negative or no relationship between metacognition and academic achievement (Sperling, Howard, Stanley & Dubois, 2004; Sperling Howard, Miller & Murphy, 2002). For example, Sperling et al (2004) used Metacognitive Awareness Inventory (MAI) to assess college students' metacognitive awareness, and found a significant correlation between knowledge of cognition factor but found no relationship between scores on the MAI and standardized achievement test (SAT) scores that is, a form of comprehensive measures of academic achievement.

Further more, in an attempt to ascertain the relationship between metacognition and achievement, Sperling et al (2002) reviewed several literatures and reported that the relationship between metacognition and achievement or aptitude is not clear. However, they found significant correlation between metacognition and achievement for grades 3, 4 and grade 5, but observed no relationship for grade 6, 7 and 8 students' scores

Though Metacognitive knowledge may contribute significantly in the improvement of students' cognitive processes and academic achievement, the above reviewed literature on metacognition and academic achievement seems to be inconclusive as there are some inconsistencies. While some researchers found significant positive relationship, others report negative or no relationship between metacognition and students' academic achievement.

Students' attitude and academic achievement

One of the characteristics of an individual that can influence behaviour together with learning is attitude. Students' attitude and beliefs are highly associated with motivation and success. Motivation is prone to attitudinal influences vis-à-vis learning and academic achievement. For example, students who are forced by their parents to study physics which they feel or believe will not be of any benefit to them might tend to exhibit negative attitudes towards learning of physics and this negative attitudes may consequently affect their motivational levels to actively engage in the learning activities.

According to Awotua-Efebo (1999), attitudes are affective predisposition to make certain choices or to behave in certain ways, given a choice of behaviours. It is the internal state of an individual that moderates the person's of personal action or behaviour. Attitude therefore can be defined as an individual's beliefs, values or feelings of like or dislike towards a given thing (activity, person, event, image, course of study or school subjects) to the extent of developing the interest of either to or not to interact with (or learn about) the thing.

This implies that attitude has motivational properties, and they regulate and influence all behaviours (inclusive of one's academic performance or achievement). It can make or mar a student to progress in his academic endeavour.

Research findings have revealed a positive relationship between students' attitude towards school subject or course and students' academic achievement (Michelli, 2013; Kesici, Sahin & Akturk, 2009; Zainudin, Suhashilla, Najib & Hamdan, 2007, and Popham, 2005 cited in Awang, Ahmad, Bakar, Ghani, Yunus, Ibrahim, & Rahman, 2013;). According to them learners with positive attitude use more learning strategies than those with negative attitude. This implies that students who possessed favourable or positive attitude towards the subject teacher and course contents are most likely to achieve better (because they are more likely to persist and pay greater attention to learn and read more about things that appeal to their interest) than those students with less favourable attitudes.

Specifically, in the area of science subjects, few studies on the influence of students' attitude on students' academic achievement have been carried out. Jack (2013) found a significant difference in the difficulty process skills mean score in favour of chemistry students with positive attitude towards science, as they had higher mean score than those with negative attitude, and thus reported attitude as one of the variables influencing students' acquisition of science process skills.

In a study of the attitudes of secondary school students towards basic science, Alao (1988) showed that students have positive attitude towards science. Contrary to this finding, Obomanu & Adaramola (2011) and Adesokan (2002) affirm that students still exhibit negative attitude towards science. While Obomanu & Adaramola found students' negative attitude among other factors to be related to underachievement in science, technology and mathematics (STM) Education in secondary schools, Adesokan reported that students' negative attitude towards chemistry leads to low enrolment and poor academic performance in the subject. However, Osborne, Simon & Collins (2003) reviewed several literature on attitude toward science and found a decline in attitudes of students towards science from age 11 upward as they (the students) progress through their schooling years. These findings therefore, reveals the need for the introduction and teaching of science to students at their early school age so as to enable them develop positive attitude or disposition towards science in later years of their life.

In acknowledgement of the effect(s) of students' attitude on academic performance, attitude is a determining factor of what students learn. Students with positive attitude towards a subject, the subject teacher or the instructional mode are likely to develop interest, and sustain their efforts in the learning of the subject which in turn would lead them to achieve success in the subject. Bearing this in mind, this study seeks to determine the relationship between students' metacognition, attitude and academic achievement. However, the objectives of the study are to investigate the relationship between metacognition and academic achievement, relationship between attitude and academic achievement; and the predictive power of both students' metacognition and attitude on academic achievement in chemistry.

Hypotheses

The following null hypotheses guided the study.

H_O1: Metacognition and attitude do not significantly correlate with academic achievement in chemistry.

H_O2: The mean chemistry achievement score of students possessing high metacognition and positive attitude is not significantly higher than that of those with low metacognition and negative attitude.

H_O3: Attitude does not strongly predict students' academic achievement in chemistry more than metacognition.

III. Methodology

Design

The study is exploratory in nature. It employed correlational design with metacognition and attitude as independent (predictive) variables and academic achievement as the dependent variable.

Participants

The target population of the study consisted of all Senior Secondary Two (SS2) Chemistry students of 2014/2015 academic session in the Senior Secondary Schools located in Port Harcourt Local Government Area (PHALGA) Education zone, Rivers State, Nigeria. However, the accessible population comprised of all the SS2 chemistry students in public coeducational Senior Secondary Schools in PHALGA education zone from which a total of 600 randomly selected students drawn from eight secondary schools participated in the study.

Instruments

Chemistry Students'Metacognitive Assessment Scale (CSMAS) and Chemistry Students' Attitude Probe (CSAP) were employed to generate data for the study. CSMAS is a 40- item while CSAP is a 30-item developed on a 4-point modified Likert type scale ranging from Strongly Agreed (SA) = 4points, Agreed (A) =3points, Disagreed (D) = 2points to Strongly Disagreed (SD) = 1point. By this, a respondent is to score a maximum of 160 points and a minimum of 40 points on CSMAS, and a maximum of 120 points and a minimum of 30 points on CSAP. Both CSMAS and CSAP were developed by the researchers and validated by two educational psychologists. They were pilot tested on 84 SS2 students of non-participating schools and applying Cronbach Alpha technique gave the reliability,α, for CSMAS and CSAP as 0.81and 0.74 respectively.

Procedure

The principal and SS2 chemistry teachers of the participating schools were contacted and permission sought to use their students for the study. With the assistance of the chemistry teacher CSMAS and CSAP were administered to the participants. The participants completed the instruments within 40 minutes and the instruments retrieved on the spot. Total CSMAS score and total CSAP score obtained by each participant was separately transformed to 100% to obtain the participant's percentage score in CSMAS and CSAP respectively. Data from CSMAS and CSAP was respectively used in the grouping of students according to their levels of metacognition (as high or low) and levels of attitude (as positive or negative) based on a cut-off mean of 2.5 on four-point scale; with a mean of 2.5 and above for positive (or high) and amean below 2.5 for negative (or low). End of term chemistry examination scores (used as a measure of Chemistry academic achievement) of the participants was collected from the principals and SS2 chemistry teachers of the participating schools..

IV. Method of Data Analysis

Pearson Product Moment Correlation, t-test and multiple regression analysis were used to analyse data, as well as testing the stated hypotheses at .05 significant levels. Data were processed using IBM SPSS statistics 20.

V. Results And Discussion

Results

Table 1. Zero-order correlations among metacognition, attitude and academic achievement.

	Academic Achievement	Metacognition	Attitude
Academic Achievement	1.000	.257*	.499*
Metacognition	.257*	1.000	.194**
Attitude	.499*	.194**	1.000

* p< .001, **p < .01

Results presented on table 1 showed that the relationship between metacognition and students' academic achievement is significantly positive (r =.257, p <.001). The table also revealed the existence of a significantly positive correlation between students' attitude and academic achievement (r = .499, p<.001), and between metacognition and attitude (r = .194, p<.01).

Table 2. t-test of mean difference in chemistry achievement scores

Groups	N	Mean	Std. Dev.	T	Df	Sig.(2 tailed)
High metacognition & positive attitude	269	62.736	15.201	3.458	598	. .001
Low metacognition & negative attitude	331	57.982	17.909			

Result presented in table 2 showed that at p = .001 and df = 598, t_{cal} = 3.458. Since p<.05, it depicts that students who possess both high metacognition and positive attitude achieve significant higher mean score in chemistry than those having both low metacognition and negative attitude. Hence the rejection of Ho2 which predicted no significant difference in mean chemistry achievement scores between the two groups.

Table3. Stepwise multiple regression analysis result of students' metacognition, attitude and academic achievement.

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta (β)		
1	(Constant)	50.889	4.367		11.653	.000
	Metacognition	.230	.062	.257*	3.741	.000
2	(Constant)	21.287	5.501		3.870	.000
	Metacognition	.149	.055	.167**	2.695	.008
	Attitude	.658	.087	.466*	7.546	.000

*p< .001, **p < .01, R^2=.066 for model 1, $\triangle R^2$= .209 for model 2 (Ps =.001

Results of multiple regression analysis presented in table 3 indicated that when metacognition alone was the predictor, R^2 for model 1 was .066 (i.e. 6.6%), meaning that 6.6% of the variance in students academic achievement in chemistry was contributed by metacognition, while for model 2 when both metacognition and attitude are the predictors rose to . 275 giving a $\triangle$R2 value as .209. This means that metacognition and attitude jointly contribute 27.5% (out of which metacognition accounts for 6.6% while attitude accounts for 20.9%) of the variability of students' academic achievement in chemistry. The standardized beta (β) value which explain how the standard deviation of each of the predictor variable varies with the outcome variable revealed that for model 1, a significant positive relationship exist between metacognition and academic achievement (β =.257, p<.01). Also, for model 2 a significantly positive correlation exist between metacognition and academic achievement (β =.167, p<.01), and between attitude and academic achievement (β =.466, p<.00). More so, the t-value indicated that for model 2, attitude (t= 7.546, p<.001) accounts for students' academic achievement more than metacognition (t=2.675, p<.01).

VI. Discussion

The concern of this study was to assess the relationship among students' metacognition, attitude and academic achievement in secondary school chemistry. The result showed significantly positive correlations among the variables under investigation. Meaning that students who had higher score in the predicting variables (metacognition and attitude) had higher score in the outcome variable (academic achievement).

Result on the relationship between metacognition and academic achievement uphold results of previous studies (Bogdanović, Obadović, Cvjetićanin, Segedinac & Budić, 2015; Narang & Saini, 2013; Rahman, Jumani, Chandy, Christi, & Abbasi, 2010; Topçu & Yilmaz-Tüzün, 2009; Young & Fry,2008; Schraw, Crippen & Hartley,2006; Coutinho, 2006) that reported positive correlation between metacognition and academic achievement. They found that students with high metacognition are more strategic, and are able to engage in self-regulated learning as well as using problem solving strategies effectively, and therefore achieve significant higher academic score than those with low metacognition. This finding therefore suggests that students having good metacognition are likely to achieve academic success in chemistry and thus depicting metacognition as a good predictor of academic achievement.

With regard to students' attitude and academic achievement, the result is consistent with previous studies (Semukoro, Orobia & Arinaitwe, 2013; Erdogan, Bayram & Deniz, 2013; Zainudin, Suhashilla, Najib & Hamdan, 2007, and Popham, 2005 cited in Awang, Ahmad, Bakar, Ghani, Yunus, Ibrahim,……, & Rahman, 2013; Olatoye, 2002) that found a significantly positive correlation between attitude and academic achievement. This result therefore proves that one's achievement in a school subject depends on the individual's acquisition of the right attitude towards the subject, the subject teacher as well as the necessary school programmes and activities.

The result of this study further showed that students who possess both high metacognition and positive attitudes achieve significantly better than those who had both low metacognition and negative attitude. This finding corroborate with Walters (2003), Boekaerts and Corno (2005) who argued that for students to effectively learn and achieve academic success, they must exhibit self-regulation of cognition and behaviour. According to them, self-regulated learner need to have cognitive and metacognitive abilities in addition to motivational beliefs required to engage in effective thinking and learning. This result stresses the influential role of the combine effect of cognitive processes and affective orientations in promoting students' learning and achievement. Thus, suggesting that chemistry students need not only have the metacgonition but also the required positive attitudes towards chemistry that can energize or motivate them to activate their metacognitive knowledge and regulation to enhance learning and academic success.

More so, result on the predictive power of metacognition and attitude on achievement showed attitude to have a strong predictive power than metacognition. In spite of the fact that students metacognition encompasses students' ability to perceive, plan, monitor, control and evaluate one's self, one's cognitive processes as well as learning strategies so as to determine areas of weaknesses that can be corrected for the purpose of achieving academic success, the students' attitude seems to play a very crucial role. This is because attitudes are the determinants of behaviour, and thus lend support to the theory of reasoned action (Fishbein & Ajazen, 2010) which proved attitude to be mostly responsible for people's action. This finding is not unexpected because attitude as an affective variable can cause a change in one's behaviour towards a thing. Thus, attitudes have the capability of influencing students' cognitive, social and emotional orientations toward education related activities and programmes, and hence can predict students' academic achievement in chemistry than any other variable.

VII. Conclusion, Implications And Recommendations

In the present study, metacognition and attitude were found to be good predictors of students' academic achievement as they significantly correlate with chemistry achievement score, though attitude seems to predict or contribute more significantly than metacognition. The implication of this is that no matter how skillful or highly metacognitive a learner may be, if he lacks the will (attitude or interest) to actively engage in learning he will not be able to activate his cognitive processes or use the desired metacognitive skills for effective learning. A combination of metacognition and attitude is considered si-ne qua non for students to engage in self-regulated learning and achieve academic success. Thus we are of the belief that development of students' metacognition and attitude is very critical in enhancing students' learning and academic achievement in chemistry. Therefore parents, teachers, curriculum designers and school heads should consider these factors as important correlates of academic success, and so strive to develop them in students.

Limitations of the study

This study has two limitations. One of which is that the sample used may not give a true representation of public coeducational secondary school chemistry students in PHALGA educational zone. Another limitation is the survey nature of the study in which the methods used in obtaining data was purely based on students' self-reported questionnaire, and so no doubt that there may be discrepancy between what the students reported and what they actually do since they are likely to give responses that are not applicable to them. So, replicating this study using a larger sample as well as using observational techniques in obtaining data on students' metacogniton and attitude will help in ascertaining the veracity of the study.

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