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Research Article

Relationship between Metacognition, Locus of Control, and Academic Achievement in Secondary School Chemistry Students in Anambra State, Nigeria

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This study examined the relationship between metacognition, locus of control, and academic achievement in secondary school chemistry students in Anambra state, Nigeria. The sample consisted of 135 chemistry students in Awka Education Zone, Anambra state. Descriptive survey research design was adopted, and two instruments—Metacognitive Awareness Inventory (MAI) and Academic Locus of Control Scale—were used as instruments for data collection. Correlation and regression analyses were used to explore the intervention effects of metacognition between locus of control and academic achievements of chemistry students on the hypothesis that metacognition affects locus of control and academic achievement. The result revealed that metacognitive awareness overall, metacognitive knowledge (declarative, procedural, and conditional), and metacognitive regulation (planning, information management, monitoring, debugging, and evaluation) aspects showed a positive relationship with the students' academic achievement and a negative relationship with locus of control. The study has implication for teachers and students since metacognition can be taught. The students should avail themselves the opportunity to acquire metacognitive skill and strategies, while teachers should themselves train students on the most effective metacognitive skills and strategies for effective increase on academic achievement and locus of control.

1. Introduction

In Nigeria, great importance has been placed on education especially secondary school level of education. The age bracket of students in this level is 10–21 years which gives reason for much emphasis focused on the curriculum and students' academic achievement because of its direct positive link to national development. Education is perceived as the raw materials that shape a country's economy [1]. According to Malcolm X (n.d), "education is the passport to the future, for tomorrow belongs to those who prepare for it today." National expectation is that young students in secondary schools today are the leaders of tomorrow, and their academic achievement is the basis for gaining admission into higher institutions and the future manpower for the nation. Rightly observed by Malcolm X (n.d) [2] when he said "an investment in knowledge pays the best interest," regrettably, secondary school students' academic achievement in Nigeria has been a matter of concern especially in science subjects in which chemistry is a part of. Many researchers in recent times are interested in the factors affecting academic achievement with a view to finding permanent solutions to the problems of poor academic achievement of secondary school students in science subjects generally and chemistry in particular [3–5]. It is on this premise that the current study was conducted to examine the influence of some psychological factors on students' academic achievement. Academic achievement which is the yardstick to measure educational outcomes is paramount to the economic, scientific, and technological advancement of a nation [5]. It is used to measure the extent to which a student, teacher, school, or institution has achieved the stated educational goals [6, 7]. Many factors have been identified as affecting the academic achievements of secondary school students and these include teacher factor, environmental factor, student factor, and psychological factors [8–10]. The relationship of a number of psychological variables to academic achievement has been investigated overtime [11–13]. Majorly, this study builds on the existing research in the educational psychology domain that focuses on learning skills of students with a view to improve students' learning skills and encourage effective teaching practices by teachers. This study examined the relationship between metacognition, locus of control, and academic achievement in secondary school chemistry students in Anambra state, Nigeria.

1.1. Metacognition. Metacognition has often been conceptualized as an individual process as founded by Flavell [14], anchored on Piaget's individual-based stage theory of cognitive development [15]. Metacognition is the active process of reflecting unreservedly on one's own cognitive activities: "personal habits, growth in knowledge, and ways of learning" [16, 17]. It increases self-directed, self-regulated reflection on one's learning practices and transfer of skills [18]. It is defined as an awareness of one's learning or rational processes [19] and an umbrella term that describes several sets of mental processes [11]. There are two known components of metacognition, metacognitive knowledge, and metacognitive regulation. Metacognitive knowledge has subcomponents outlined as declarative knowledge, procedural knowledge, and conditional knowledge [20]: declarative knowledge (knowledge of what occurs within oneself and the patterns of the occurrences), procedural knowledge (knowledge of how to apply the occurrences and patterns to situations), and conditional knowledge (knowledge of why and when to use the occurrences). Metacognitive regulation has five subcomponents outlined as planning, comprehension monitoring, information management, debugging, and evaluation. Planning embraces outlining a cognitive task by laying out strategies involving cognitive resources. Comprehension monitoring has to do with recognition of one's progress in a cognitive task and his strength to accomplish the task. Information management involves operating effectively the cognitive ideas received to obtain required objectives. Debugging involves removing, ridding, or excluding cognitive tasks that do not lead to required objectives. Evaluation is assessing the outcome of one's cognitive task and the processes by which they were accomplished if it achieved the set objectives of the task [20]. Researchers suggest that these eight subcomponents of metacognition contribute immensely to increase academic achievement [21, 22] and facilitate metacognition during mathematical problem-solving [23]. Metacognition includes mental processes enabling people understand their cognitive behaviours beyond educational settings.

1.2. Metacognition and Locus of Control. Researchers in educational psychology highlighted numerous personality variables that relate to one's ability to learn and attain to desired level of objectives [20, 24, 25]. Such personality variables include motivation, self-regulation, self-efficacy, self-esteem, metacognition, locus of control, self-examining, and attribution. These variables do not necessarily singly influence personalities as many factors are involved, such as environment, social-cultural believes, peers, social status, and economic status. These personalities overlap and relate in their influences in one's life. Research shows that metacognition and locus of control relate to academic achievement [11, 12, 26]. Specifically, both metacognition and locus of control are self-beliefs which can act as an interpersonal resource that individuals create about themselves and their interaction with their social environment(s) [27] in [11]. Locus of control involves the assumption that one is able to perform a given task. Locus of control relates to attribution within the social learning theory. Rotter [28] indicated that there are two types of locus of control: internal and external locus of control. Internal locus of control is portrayed in people who accept that outcome or products are the result of their actions or inaction indicating that they are responsible for the outcome of their results. On the other hand, people with external locus of control believe they are not responsible for the happenings in their life attributing it to luck or chance. Students with internal locus of control exert greater amount of effort than those with external locus of control because they use their cognition believing that they are able to control the outcomes of their own and others' actions. In this regard, we hold that metacognition relates to a great extent of academic outcome as well as the locus of control of learners.

1.3. Metacognition and Academic Achievement. Importance of metacognition in academic achievement cannot be overemphasized. Learners as well as educators are influenced by their cognition of objectives of the curriculum, and this means that metacognition helps learners to be more involved with the learning process [29] in [20]. It is a strong predictor of academic achievement [30, 31]. Achufusi et al. [32] affirmed that students when taught with Metacognitive Learning Model (MLM) significantly improved their achievement and that gender has no significant effect on the achievement of students taught with MLM. The implication of this is that the MLM is not gender biased. Schmidt and Ford [33] established that metacognitive activities always lead to successful acquisition of relevant knowledge. Developing students' metacognitive knowledge of how they learn—their knowledge of themselves as a learner, of strategies, and of tasks—is an effective way of improving students' academic outcomes. Babbs and Moe [34] argued that students are better able to control their studying when they learn to understand their own cognitive processes.

1.4. Statement of the Problem. Studies abound on the relationship between metacognition and academic achievement [20, 31], locus of control, and academic achievement [35, 36]. Many researchers reported a positive correlation between metacognition and academic achievement as well as locus of control and academic achievement. Also, literature reveals inconclusive result on metacognition mediating between the locus of control and academic achievement, and most of these studies were done outside Nigeria. This prompted the present study in Anambra state, Nigeria, to investigate the relationship between metacognition, locus of control, and achievement in secondary school chemistry students in Anambra state, Nigeria. Formulated hypotheses were tested using data generated in the present study.

1.5. Hypotheses

(1) There is no relationship between metacognition and academic achievement of students with internal locus of control

(2) There is no relationship between metacognition and academic achievement of students with external locus of control

(3) There is no relationship between metacognition, locus of control, and achievement in secondary school chemistry students

2. Method

2.1. Participants. 135 grade XII (12) chemistry students (53 males and 82 females) from ten (10) secondary schools in Awka Education Zone of Anambra State were enrolled for the study. They were all the students who registered for chemistry in West African Senior School Certificate Examination (WASSCE) 2019 in the zone. The average age of participants was 17.43 years (SD = 1.67). Consent of the school administrators as well as that of the students was obtained before they were enrolled for the study, and the students were fully aware that the survey was entirely for academic purpose.

3. Materials

Metacognitive Awareness Inventory (MAI) designed by Schraw and Dennison [37] was used for the study. MAI is a 52-item self-report scale using true or false. The scale is divided into two: knowledge of cognition and regulation of cognition. Knowledge of cognition has seventeen items, for example, "I am aware of what strategies I use when I study," and regulation of cognition has thirty-five items, for example, "I ask myself questions about how well I am doing while learning something new." The exploratory factor analysis results showed eight factors of the items which are (1) declarative knowledge, (2) procedural knowledge, (3) conditional knowledge, (4) planning, (5) monitoring, (6) information management, (7) debugging, and (8) evaluation. Arslan and Akin [11] established a reliability of coefficient of this instrument at 0.95 for the entire scale, ranging 0.93 and 0.98 for the subscales. The test-retest reliability coefficient of the metacognitive awareness inventory over the three-week period was 0.95, and also Abdellah [20] subjected the instrument to Cronbach alpha reliability measure in Ajman UAE and obtained MAI knowledge, 0.78; MAI regulation, 0.81; and MAI total, 0.79. The MAI was subjected to content validity in order to ascertain its suitability in Nigerian context by submitting to experts in psychology and also experts in measurement and evaluation to ensure face and content validity. Calculating the reliability coefficient using Cronbach alpha, MAI knowledge of cognition was 0.72, while MAI regulation of cognition was 0.76 and MAI overall was 0.74. Locus of control scale (LOC) designed by Nowicki and Strickland [38] was used for the study. LOC is a 40-item scale using yes or no response rating, for example, "do you believe you can stop yourself from catching a ball?" "Most of the time, do you feel that getting good grades means a great deal to you?" The two subscales of the instrument are external locus of control and internal locus of control. The score ranges from 0 (internal) to 40 (external). A higher score above 50% indicates the respondent has external locus of control, and lower score tends to internal locus of control. The instrument was also subjected to validity test using test-retest method which gave a reliability coefficient of 0.76.

The average of students' cumulative score in chemistry examinations was used as the academic achievement scores. First and second terms chemistry examination scores were collected for all the participants, and the average was obtained for the purpose of data analysis. The range of the scores was obtained as 34–82. 34 was the lowest score, and 82 was the highest score.

4. Results

4.1. Descriptive Statistics for the Sample. Table 1 shows mean and standard deviation (SD), maximum and minimum of the students' scores in achievement, metacognition, and locus of control. The variance in achievement was much with a SD of 10.72. Also, locus of control has high spread from the mean, but metacognition of the students has a close cluster round the mean. From the SD of the subcomponents of metacognition, there are some less than one showing the students' metacognitive ability is almost same. It is, therefore, necessary that other statistical measures apply to ascertain the relationship between metacognition, locus of control, and academic achievement of the students.

From Table 2, there was a significant correlation between academic achievement and metacognition in the subcomponents. From the knowledge of cognition, only conditional knowledge ($r = -0.322$, $p < 0.01$) correlated with academic achievement. Knowledge of regulation (subcomponent of metacognition) correlates with academic achievement in the following sub-subcomponents, planning ($r = -0.257$, $p < 0.01$), information management ($r = -0.230$, $p < 0.01$), debugging ($r = -0.331$, $p < 0.01$), and evaluation ($r = -0.351$, $p < 0.01$). However, there was no correlation between the following subcomponents of metacognition and academic achievement nor internal locus of control. Declarative knowledge ($r = -0.113$, $p = 0.193$), procedural knowledge ($r = -0.137$, $p = 0.112$), comprehension monitoring ($r = -0.155$, $p = 0.072$), and internal locus of control ($r = 0.027$, $p = 0.802$). From Table 2, it was clear that metacognition has no correlation with the students' internal locus of control. Table 2 also showed that knowledge of cognition correlates positively with knowledge of regulation in some subcomponents, procedural knowledge correlates

Table 1: Descriptive statistics of the variables.

	N	Minimum	Maximum	Mean	Std. deviation
Achievement	135	34.00	82.00	56.7111	10.71675
Declarative knowledge	135	8	21	9.91	1.695
Procedural knowledge	135	4	7	4.67	0.810
Conditional knowledge	135	5	10	5.93	0.971
Planning	135	7	12	8.33	1.252
Information management strategy	135	10	24	12.01	1.781
Comprehension monitoring	135	7	19	8.39	1.476
Debugging	130	4	7	4.56	0.778
Evaluation	135	6	11	7.07	1.114
External LOC	47	24.00	40.00	34.2128	4.11749
Internal LOC	89	5.00	20.00	13.0674	3.69212
Valid *N* (listwise)	1				

Table 2: Correlation of metacognition, academic achievement, and internal locus of control of students.

	1	2	3	4	5	6	7	8	9	10	11	12	13
(1) Gender	1												
(2) Option	−0.206*	1											
(3) Achievement	0.015	−0.055	1										
(4) Metacognition	0.010	0.013	−0.411**	1									
(5) Declarative knowledge	−0.066	−0.001	−0.124	0.603**	1								
(6) Procedural knowledge	0.042	−0.049	−0.142	0.541**	0.282**	1							
(7) Conditional knowledge	−0.044	0.204*	−0.326**	0.457**	0.178*	0.370**	1						
(8) Planning	−0.101	−0.047	−0.259**	0.638**	0.313**	0.366**	0.257**	1					
(9) Information management	0.093	0.018	−0.219*	0.594**	0.128	0.192*	0.207*	0.293**	1				
(10) Comprehension monitoring	0.081	−0.040	−0.163	0.699**	0.208*	0.314**	0.278**	0.392**	0.381**	1			
(11) Debugging	−0.116	0.079	−0.331**	0.560**	0.208*	0.247**	0.224*	0.222*	0.304**	0.314**	1		
(12) Evaluation	−0.059	0.059	−0.363**	0.607**	0.204*	0.265**	0.217*	0.316**	0.325**	0.350**	0.432**	1	
(13) Locus of control	−0.112	−0.084	0.161	−0.132	−0.095	0.031	−0.073	−0.062	−0.087	−0.076	−0.062	−0.075	1

*Correlation is significant at 0.05 level (2-tailed). **Correlation is significant at 0.01 level (2-tailed).

with declarative knowledge ($r = 0.261$, $p < 0.001$), and conditional knowledge correlates with procedural knowledge ($r = 0.379$, $p < 0.001$). The relationship between other subcomponents of metacognition is expressed as follows: planning relates with declarative ($r = 0.306$, $p < 0.001$), planning connects to procedural knowledge ($r = 0.338$, $p < 0.001$), planning connects to conditional knowledge ($r = 0.252$, $p < 0.001$), information management relates with procedural knowledge ($r = 0.193$, $p < 0.001$), conditional knowledge ($r = 0.212$, $p < 0.05$), and planning ($r = 0.293$, $p < 0.05$). Comprehension monitoring correlates with declarative knowledge ($r = 0.178$, $p < 0.05$), procedural knowledge ($r = 0.314$, $p < 0.001$), conditional knowledge ($r = 0.278$, $p < 0.001$), planning ($r = 0.398$, $p < 0.001$), and information management ($r = 0.280$, $p < 0.001$). Debugging correlates with declarative knowledge ($r = 0.211$, $p < 0.05$), procedural knowledge ($r = 0.254$, $p < 0.001$), conditional knowledge ($r = 0.215$, $p < 0.05$), planning ($r = 0.179$, $p < 0.05$), information management ($r = 0.298$, $p < 0.001$), and comprehension monitoring ($r = 0.299$, $p < 0.001$). Evaluation correlates with declarative knowledge ($r = 0.177$, $p < 0.05$), procedural knowledge ($r = 0.264$, $p < 0.001$), conditional ($r = 0.204$, $p < 0.05$), planning ($r = 0.300$, $p < 0.001$), information management ($r = 0.301$, $p < 0.001$), comprehension monitoring ($r = .338$, $p < 0.001$), and debugging ($r = 0.425$, $p < 0.001$). It is clearly observed that metacognition mediates not between the locus of control and academic achievement, and the hypothesis was therefore not rejected. Table 2 shows a positive relationship of metacognition subcomponents to academic achievements of students as seen in Table 2 without any connection to their external locus of control. The result shows that the knowledge of cognition and knowledge of regulation correlates positively and relates to academic achievement but are unrelated to the external locus of control of the students. All subcomponents of metacognition correlate with achievement except declarative knowledge ($r = -0.113$, $p = 0.193$), procedural knowledge ($r = -0.137$, $p = 0.112$), and comprehension monitoring ($r = -0.155$, $p = 0.072$) and no connection with external locus of control of the students. The hypothesis is not rejected. To verify the relationship between metacognition, academic achievement and locus of control without the subcomponents, Pearson correlation was used.

Table 3 clearly shows that academic achievement was correlated with metacognition ($r = -0.287$, $p = 0.001$) but was unrelated to locus of control ($r = -0.166$, $p = 0.054$). To verify to what extent, we can explain the academic achievement of students from their level of metacognition and their locus of control, regression analysis was employed.

From Table 4, metacognition positively related to academic achievement (F (2,132) = 7.292, $p = 0.001$, $\beta = -0.271$), and locus of control was unrelated to achievement (F (2,132) = 0.639, $p = 0.118$, $\beta = -0.131$). Only 9% accounts for the relationship of metacognition and locus of control on academic achievement.

Table 3: Correlation of metacognition, locus of control, and academic achievement.

	1	2	3
(1) Achievement	1		
(2) Locus of control	−0.166	1	
(3) Metacognition	-0.287^{**}	0.129	1

5. Discussion

This study examined the relationship between metacognition, locus of control, and academic achievement in secondary school chemistry students. Metacognition correlated positively with academic achievement. The positive correlation between metacognitive and academic achievement is in line with the findings of [39] in which they found a significant positive relationship between metacognition and educational performance. In addition, the authors of [20, 31, 40] also found a significant positive relationship between metacognition and academic achievement. This positive relationship between metacognition and academic achievement implies that, as the use of metacognition increases, one's academic average increases. The result shows metacognition correlates negatively with locus of control. This negative correlation of metacognition with locus of control is not the same as the findings of [11] which stated that metacognition predicts positively internal locus of control and negatively external locus of control. Other researchers [41, 42] also asserted a moderate correlation of academic achievement with internal beliefs, therefore indicating a positive relation between metacognition and internal locus of control. A student with an internal locus of control attributes success to his or her own efforts and abilities. Findley and Cooper [43] concluded in their study that the relationship between academic achievement and locus of control proved that students with internal locus of control achieve a higher level of academic averages than students with external locus of control. To obtain higher levels of academic averages, cognitive and metacognitive strategies are used often by the student. Also, students with higher abilities to control and monitor their own cognitive processes and their own learning strategies often achieve better results in learning. According to Dornyei [44] cognitive strategies include different ways in which people control their learning, memorizing, and thinking. Hendry [45] defines cognitive strategies as a variety of approaches to problem solving and critical thinking and declares cognitive strategies as explorations of processes of information processing, as in the process of information retention, individuals require external stimuli, which means that educational and creative activities are to be regulated. Cognition is the way in which information is considered, conceded, recognized, examined, encoded and stored in memory, and retrieved and then used when needed. Cognition in this process relates metacognitive regulation which relates to self-regulation. Metacognitive regulation has five subcomponents outlined as planning, comprehension monitoring, information management, debugging, and evaluation. Planning embraces outlining a cognitive task by laying out strategies involving cognitive resources. Comprehension monitoring has to do with recognition of one's progress in a cognitive task and his strength to accomplish the task. Information management involves operating effectively the cognitive ideas received to obtain required objectives. Debugging involves removing, ridding, or excluding cognitive tasks that do not lead to required objectives. Evaluation is assessing the outcome of one's cognitive task and the processes by which they were accomplished if it achieved the set objectives of the task [20]. Self-regulation is defined as "self-generated thoughts, feelings, and actions that are planned and adapted to the attainment of personal goals" ([46] p. 14). Self-regulated learning theory asserts that self-regulation develops across four levels: observational, imitative, self-controlled, and self-regulated levels [46]. Observational and imitative levels, focusing on external social factors, depend on modeling and social guidance, respectively. Self-controlled and self-regulated levels are obtained from internal skills. At the self-controlled level, learners create internal standards for acceptable performance and become self-reinforcing via positive self-talk and feedback [47]. They also suggest that, at the self-regulatory level, individuals develop self-efficacy beliefs, as well as higher-order cognitive strategies, that enable them to self-regulate their learning. Empirical studies indicated a significant relationship between academic success and the use of regulatory skills and an understanding of how to use these skills [48, 49]. These studies indicates that one with internal locus of control has self-regulated skills which enables him/her to achieve high academic averages, hence the high significance of metacognitive regulation with academic achievement. The result also showed a significant positive relationship between academic achievement and metacognitive regulation but not with metacognitive knowledge. This could be that metacognitive regulation, the knowledge about one's learning strategies rather than metacognitive knowledge, is more dominant in students as a significant factor in academic achievement. Metacognitive regulation subcomponents correlate with one another—planning, information management, comprehension monitoring, debugging, and evaluation—and with academic achievement positively. The positive relationship indicates that cognitive regulation increases the academic achievement. However, this study did not find metacognition as a predictor of locus of control.

Table 4: Relationship between metacognition, locus of control and academic achievement.

Model	Unstandardized coefficients *B*	Standardized coefficients Std. error	*T* Beta	Sig.	Unstandardized coefficients
1 (constant)	89.134	9.147		9.744	0.000
Metacognition	−0.485	0.149	−0.271	−3.248	0.001
Locus of control	−0.130	0.082	−0.131	−1.574	0.118

[a]Dependent variable: academic achievement.

6. Conclusion and Recommendation

The conclusion of the study is that metacognition has a positive correlation with academic achievement. The study evinced that the positive components of metacognition (procedural knowledge, conditional knowledge, planning, information management, comprehension monitoring, debugging, evaluation, and overall metacognition) exhibited mostly significant correlations with academic achievement. The result indicates that no matter how the students perceive their academic achievement, whether as their mastery of skills or external factor/luck, locus of control was not a factor to their outcome but that metacognition has a strong influence on academic achievement. Metacognition and locus of control are both self-belief systems which individuals creates about themselves as they interact with their social environment, hence expecting to relate positively to bring about an influence on skill mastery. The study has implication for teachers and students since metacognition can be taught. The researchers recommend that students should avail themselves the opportunity to acquire metacognitive skill and strategies, while teachers should themselves train students on the most effective metacognitive skills and strategies for effective increase on academic achievement and locus of control. Other factors may have resulted in the present result. Metacognition can be taught to students wishing to improve their locus of control and academic achievement to see if new findings can be established. The use of mixed method would come up with new findings and will enlighten the dynamics of academic achievement.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare no conflicts of interest.

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