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HOW METACOGNITIVE LEARNING STRATEGIES AND ACADEMIC SELF-EFFICACY AFFECT THE ACADEMIC PERFORMANCE OF COLLEGE STUDENTS IN CHEMISTRY EXAMINATION.

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ABSTRACT
There are wide range of factors affecting the overall academic success of undergraduate students engaged in chemistry examinations. This study examines how metacognitive learning strategies and academic self-efficacy affects the academic performance of students in chemistry modules. This study was carried out on 100 undergraduate students studying integrated science/mathematics as a double major at the Adeyemi Federal University of Education, Ondo, Nigeria. A major part of the integrated science/ mathematics curriculum involves general and core chemistry modules, as such the students filled out two questionnaires based on metacognitive learning strategies and academic self-efficacy questions. The data were analyzed using SPSS and Smart PLS3. The results showed that students' self-efficacy and metacognitive learning strategies play a significant role on students' academic performance during chemistry examinations and that these parameters affect students' academic performance in chemistry positively.

Keywords*: Academic self-efficacy, Metacognitive strategies, Academic performance, Chemistry.*

1.1 INTRODUCTION

The concept of metacognition in the process of learning is an old idea that can be traced from Socrates' questioning methods to Dewey's twentieth-century stance which infer that we learn more from reflecting on our experiences than from the actual experiences themselves (Dewey, 1933). Credited to developmental psychologist John Flavell in a publication from the 1970s, metacognition is used in different disciplines in different ways, and a common, succinct definition appears to be elusive in the literature.

Metacognition refers to one's knowledge concerning one's own cognitive processes or anything related to them, e.g., the learning-relevant properties of information or data. For example, I am engaging in metacognition if I notice that I am having more trouble learning A than B; if it strikes me that I should double check C before accepting it as fact (Flavell, 1976).

Academic self-efficacy is one of the important factors influencing academic performance. Academic self-efficacy refers to the students' beliefs and attitudes toward their capabilities to achieve academic success, as well as belief in their ability to fulfill academic tasks and the successful learning of the materials (Bandura, 1997, Schunk & Ertmer, 2000). Self-efficacy beliefs lead to the individuals' excellent performance through increasing commitment, endeavor, and perseverance. The learners with high levels of self-efficacy attribute their failures to lower attempts rather than lower ability, while those with low self-efficacy attribute their failure to their low abilities (Kurbanoglu & Akim, 2010). Therefore, self-

efficacy can influence the choice of tasks and perseverance while doing them. In other words, students with low self-efficacy are more likely to be afraid of doing their tasks, avoiding, procrastinate and eventually give them up soon (Bandura, 1997, Schunk & Ertmer, 2000).

In the cognitive pathway, self-efficacy in form of motivations can influence one's performance through five mechanisms, including performance experience, vicarious experience, social persuasion, imaginal experience and physical and emotional state. In contrast, positive emotions resulting from the use of deep, flexible, and complex learning strategies and self-regulation facilitate the individuals' learning, so that the students who experience good self-efficacy utilize deeper strategies and more metacognitive processing, that, in turn, enhances the students' achievement

1.2 Statement of Research Problems

Most of the researches on self-efficacy and metacognitive learning strategies have been conducted using correlation analysis, qualitative methods and experimental approaches; they have revealed a positive and simple relationship between these variables and academic performance and have not shown direct and indirect effect of these variables on each other. Moreover, most of these studies have been carried out in the field of psychology, social sciences, and education and the results of these studies cannot be generalized to the science education context. Since the nature of the academic field is supposed to affect the students' learning strategies, there may be a difference between chemistry students' learning approaches when compared with those of other students in higher education.

1.3 Hypotheses

H1: Academic self-efficacy has a direct effect on academic performance.

H2: Metacognitive learning strategies have a direct effect on academic performance.

H3: Academic self-efficacy has a direct effect on metacognitive learning strategies.

H4: Metacognitive learning strategies mediate the relationship between academic self-efficacy and academic performance.

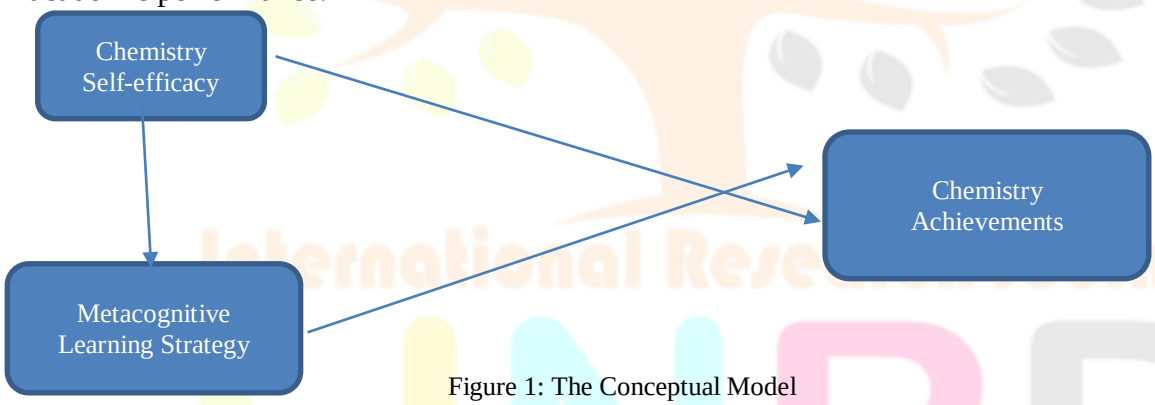

Figure 1: The Conceptual Model

3.1. Procedures and Participants

This cross-sectional study was conducted on 100(females and males) Integrated science degree students studying in their 300L to 400L (chemistry courses) in the 2020-2021 academic years at Adeyemi College of Education, Ondo, Nigeria. The response rate of the participants was 90/100 (79%). Each year about 60 degree students enter Adeyemi College of Education, Ondo, Nigeria. Students' Chemistry courses were investigated in each semester of the academic year. The students aged between 18 and 26 years old (mean 19.6, SD 3.2). size satisfied both views. The subjects were selected using the convenience sampling method. This study was approved by the Research Ethics Committee of the college. Also, the students were assured on the confidentiality of their information.

The study uses a questionnaire which comprises of three sections were applied. Section A contains the Respondents Bio-Data, Section B contains questions on Metacognitive strategy learning and section C contains questions on Self-efficacy in Chemistry.

Metacognitive learning strategies questionnaire

This questionnaire contains two subscales of motivation and self-regulated learning and has been previously used in many studies(Artino, 2010). In this study, metacognitive learning strategies subscale

consisting of 12 items was used, in which answers are scored using 5 -point Likert scale. Pintrich et al. have reported a Cronbach's alpha of 0.79 for this subscale (Pintrich et al., 1993)

Academic self-efficacy questionnaire

The new general self-efficacy scale by Chen, Gully and Eden (2001) was used. It contains 8 questions evaluating the students' beliefs regarding their abilities and performance. These items are scored using a 5 -point Likert scale. This questionnaire is highly reliable and validated and has also been used in many studies.

Academic performance

The academic performance of the participants were assessed using their final exam scores in that semester. Also semester-work activity consisting of a term paper, quizzes, and assignments were all considered as indicators of academic performance. The assignments include class presentation individually or in group which are done as a part of the course requirements. In addition, the students were assessed through formative and summative multiple-choice tests. SMART-PLS, EXCEL application and SPSS software were used to calculate the mean and standard deviation and correlation coefficients between the variables.

3.2 Results and Discussions

3.2.1 DEMOGRAPHIC ANALYSIS

The first part of the report contains the respondents' demographic distribution. This includes respondents' sex, age, programme and level in the institution.

A total of 103 respondents responded to the questionnaire, out of which 22% are male, while the remaining 78% are females (fig. 3.1).

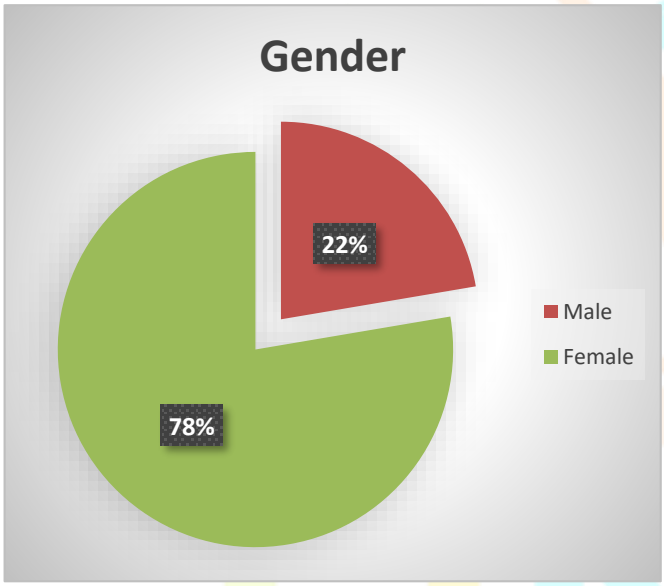

Fig. 3.1: Showing the gender of the participants

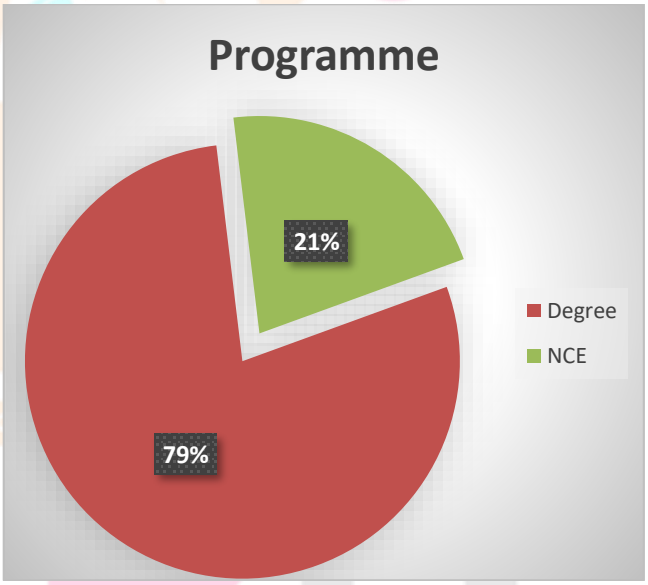

Fig. 3.2: Showing the programme of the participants

Most of the respondents are running degree program (79%) while few of them NCE (fig. 3.2).

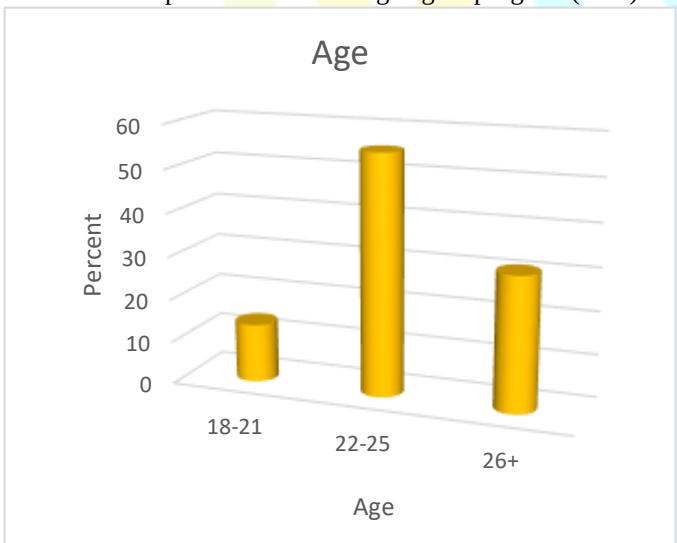

Fig. 3.3: Showing the age of the participants

Fig. 3.4: Showing the levels of the participants

3.3 ANALYSIS OF VARIABLES

3.3.1 Metacognitive Learning Strategy

Table 4.3: Items for the Metacognitive Learning Strategy

S/N		ITEMS	SA	A	N	SD	D
1.	A1	I prefer class work that is challenging so I can learn new things.	50 (48.5%)	34 (33.0%)	3 (2.9%)	11 (10.7%)	5 (4.9%)
2.	A2	Compared with other students in this class I expect to do well	51 (49.5%)	46 (44.7%)	3 (2.9%)	1 (1.0%)	2 (1.9%)
3.	A3	I am so nervous during a test that I cannot remember facts I have learned	17 (16.5%)	42 (40.8%)	9 (8.7%)	21 (20.4%)	14 (13.6%)
4.	A4	It is important for me to learn what is being taught in this class	76 (73.8%)	24 (23.3%)	1 (1%)	1 (1%)	1 (1%)
5.	A5	When I study for a test I try to remember as many facts as I can	58 (56.3%)	43 (41.7%)	1 (1%)	0 (0%)	1 (1%)
6.	A6	I think I will be able to use what I learn in this class in other classes	52 (50.5%)	41 (39.8%)	3 (2.9%)	4 (3.9%)	3 (2.9%)
7.	B1	I am sure I can do an excellent job on the problems and tasks assigned for this class	51 (49.5%)	48 (46.6%)	2 (1.9%)	1 (1%)	1 (1%)
8.	B2	Even when I do poorly on a test I try to learn from my mistakes	74 (71.8%)	26 (25.2%)	0 (0%)	2 (1.9%)	1 (1%)
9.	B3	My study skills are excellent compared with others in this class	31 (30.1%)	49 (47.6%)	11 (10.7%)	6 (5.8%)	6 (5.8%)
10.	B4	When I do homework, I try to remember what the teacher said in class so I can answer the questions correctly	66 (64.1%)	32 (31.1%)	1 (1%)	3 (2.9%)	1 (1%)
11.	B5	I ask myself questions to make sure I know the material I have been studying	70 (68.0%)	29 (28.2%)	2 (1.9%)	0 (0%)	2 (1.9%)
12.	B6	When I study for a test, I try to put together the information from class and from the book	60 (58.3%)	36 (35.0%)	5 (4.9%)	1 (1%)	1 (1%)

The table above displays the outcomes of the items measuring the metacognitive learning strategies of learners. Many of the respondents strongly agreed with the items of the metacognitive learning strategies while very few people fell below the neutral level.

Table 4.4: Items for the Academic Self-Efficacy

S/N		ITEMS	SA	A	N	SD	D
1.	C1	I will be able to achieve most of the goals that I have set for myself	80 (77.7%)	22 (21.4)	1 (1%)	0 (0%)	0 (0%)
2.	C2	When facing difficult tasks, I am certain that I will accomplish them.	54 (52.4%)	46 (44.7%)	1 (1%)	2 (1.9%)	0 (0%)
3.	C3	In general, I think that I can obtain outcomes that are important to me	61 (59.2%)	37 (35.5%)	4 (3.9%)	1 (1%)	0 (0%)
4.	C4	I believe I can succeed at most of the endeavour to which I set my mind.	69 (67%)	30 (29.1%)	3 (2.9%)	1 (1%)	0 (0%)
5.	C5	I will be able to successfully overcome many challenges.	75 (72.8%)	26 (25.2%)	0 (0%)	1 (1%)	1 (1%)
6.	C6	I am confident that I can perform effectively on many different tasks.	58 (56.3%)	42 (40.8%)	1 (1%)	1 (1%)	1 (1%)
7.	C7	Compared to other people, I can do most tasks very well.	53 (51.5%)	42 (40.8%)	6 (5.8%)	0 (0%)	2 (1.9%)
8.	C8	Even when things are tough, I can perform quite well.	55 (53.4%)	42 (40.8%)	3 (2.9%)	1 (1%)	2 (1.9%)

This study formulated four null hypotheses based on the items from the questionnaire on the variables of interest to the study. The study identified four variables where academic self-efficacy metacognitive learning strategy were identified as the independent variables with eight and twelve items respectively as in table 3.4 and 3.3 respectively. The four hypotheses were stated in terms of null hypothesis which were to be either rejected or fail to reject based on statistically significant impact test of path modeling in the partial least square structural equation model designed in Figure 3.5.

1. H_0: Academic self-efficacy has statistically significant effect on academic performance.
2. H_0: Metacognitive learning strategies have statistically significant effect on academic performance.
3. H_0: Academic self-efficacy has statistically significant effect on metacognitive learning strategies.
4. H_0: Metacognitive learning strategies mediate the relationship between academic self-efficacy and academic performance.

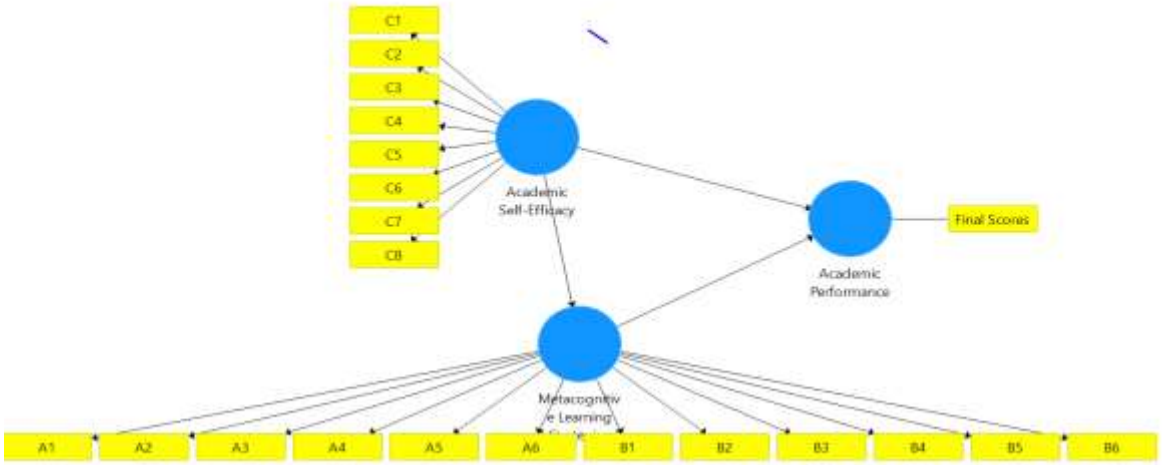

Fig. 3.5: Model Result for Academic Self-Efficacy and Metacognitive Learning Strategies' Effects on the Academic Performance of College Students in Chemistry.

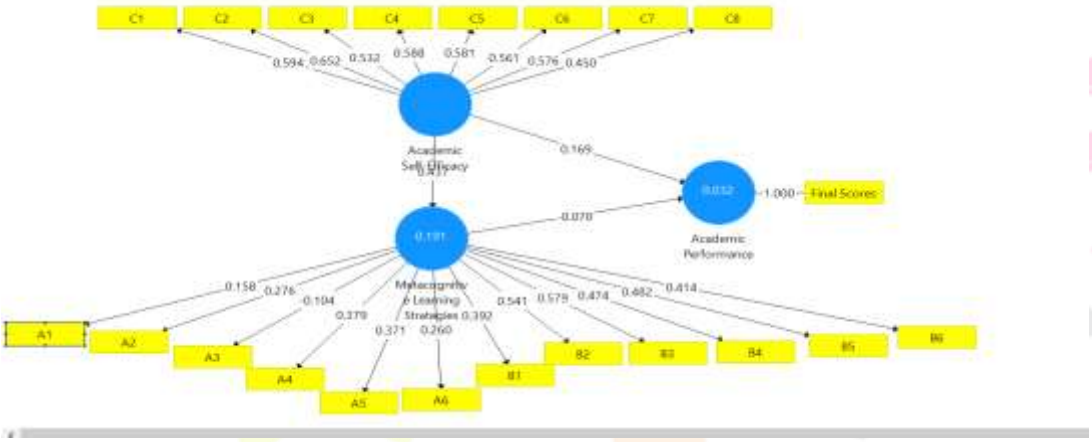

Fig. 3.6: Model Result for Academic Self-Efficacy and Metacognitive Learning Strategies' Effects on the Academic Performance of College Students in Chemistry.

Table 4.5: Validity and Reliability for Constructs.

Constructs	Items	Loadings
Academic Self-Efficacy AVE = .324 Cronbach's Alpha = .703 Composite Reliability = .792	I will be able to achieve most of the goals that I have set for myself	.535
	When facing difficult tasks, I am certain that I will accomplish them.	.643
	In general, I think that I can obtain outcomes that are important to me	.521
	I believe I can succeed at most of the endeavour to which I set my mind.	.684
	I will be able to successfully overcome many challenges.	.537
	I am confident that I can perform effectively on many different tasks.	.752
	Compared to other people, I can do most tasks very well.	.484
	Even when things are tough, I can perform quite well.	.602
Metacognitive Learning Strategy AVE = .156 Cronbach's Alpha = .702 Composite Reliability = .638	I prefer class work that is challenging so I can learn new things.	.677
	Compared with other students in this class I expect to do well	.689
	I am so nervous during a test that I cannot remember facts I have learned	.593
	It is important for me to learn what is being taught in this class	.749
	When I study for a test I try to remember as many facts as I can	.720
	I think I will be able to use what I learn in this class in other classes	.678
	I am sure I can do an excellent job on the problems and tasks assigned for this class	.769

	Even when I do poorly on a test I try to learn from my mistakes	.742
	My study skills are excellent compared with others in this class	.618
	When I do homework, I try to remember what the teacher said in class so I can answer the questions correctly	.702
	I ask myself questions to make sure I know the material I have been studying	.659
	When I study for a test, I try to put together the information from class and from the book	.602
Academic Performance AVE = 1.000 Cronbach's Alpha = 1.000 Composite Reliability = 1.000	Final Scores.	.799

Table 4.6: Discriminant validity (Squared correlations < AVE):

	Academic Self-Efficacy	Metacognitive LearningStrategies	Academic Performance	Mean C (AVE)
Academic Self-Efficacy	**1**			0.324
Metacognitive Learning Strategies	0.169	**0.569**		0.156
Academic Performance	0.017	0.437	**0.395**	1
Mean Communalities (AVE)	0.324	0.156	1	**0**

4.1. Discussion

4.2 Structural Model

This structural model was estimated to test the hypothesis raised during the study using SMART PLS software. SMART-PLS is an advanced statistical analysis software, which was designed by PLS experts and IT professionals led by Prof. Dr. Christian Ringle. The software is preferred because of its user-friendly interface and ease of access. SMART PLS is easy to use; the basic knowledge of PLS SEM is just sufficient to venture into operation with this software. Structural Equation Modelling is called a second-generation data analysis technique (Bagozzi and Fornell, 1982), it is a family of statistical models that seeks to explain the relationship among multiple variables simultaneously.

4.2.1 Hypothesis One

H_0: Academic self-efficacy has statistically significant effect on academic performance

The structural equation model path coefficient was designed to test four distinct but connected hypotheses as indicated in the structural equation model. The first hypothesis was formulated as null hypothesis which indicated that academic self-efficacy has a significant effect on academic performance. The path coefficient result reveal positive and statistically significant impact of academic self-efficacy on academic performance of students (β =0.199, P= 0.020). This factor explains clearly that academic performance of a student is determined by academic self-efficacy. It shows that there's clearly a link between academic performance and academic self-efficacy. That is, self-efficacy is one of the factors that determines academic performance.

According to Hair at el., 2013, the threshold value of 0.25, 0.5 and 0.7 are often used to describe a weak, moderate, and strong coefficient of determination, R^2 values for endogenous latent variables. This endogenous variable (Academic Performance) R^2 (0.030, Table 4.7) indicated that just 3% variation in the academic performance of students is determined by their academic self-efficacy. Hence, it can be concluded that academic self-efficacy has weak impact on academic performance.

Based on Cohen's (1988) assertion, Effect size of 0.02, 0.15, and 0.35 indicates small, medium, and large effect, respectively. Therefore, from table 4.8, f^2 = 0.033 implies that there is a weak effect of academic self-efficacy on academic performance in chemistry.

4.2.2 Hypothesis Two

H_0: Metacognitive learning strategies have statistically significant effect on academic performance

The second hypothesis was made to indicate metacognitive learning strategies have significant effect on academic performance. The path coefficient result reveal negative and statistically insignificant impact of metacognitive learning strategies on academic performance of students (β =-0.070, P= 0.200). This factor explains clearly that no significant effect of metacognitive learning strategy on academic performance of a student is determined by metacognitive learning strategies. Even though there's a direct link between academic performance and metacognitive learning strategies, metacognition does not have any significant effect (f^2 = 0.004, table 4.8) on academic performance.

4.2.3 Hypothesis Three

H_0: Academic self-efficacy has statistically significant on metacognitive learning strategies.

The third hypothesis was formulated as null hypothesis which indicated that academic self-efficacy has a direct significant effect on metacognitive learning strategies. The path coefficient result reveal positive and statistically significant impact of academic self-efficacy on metacognitive learning strategies. (β =0.437, P= 0.002). This factor explains clearly that metacognitive learning strategies of students is dependent on academic self-efficacy. It shows that there's clearly a link between metacognitive learning strategies and academic self-efficacy. That is, self-efficacy is a determinant of metacognitive learning strategies in students.

According to Hair at el., 2013, the threshold value of 0.25, 0.5 and 0.7 are often used to describe a weak, moderate, and strong coefficient of determination, R^2 values for endogenous latent variables. Hence, the variable (metacognitive learning strategies) R^2 (0.191, Table 4.7) indicated that just 19% variation in the metacognitive learning strategies of students is determined by their academic self-efficacy. Hence, it can be concluded that academic self-efficacy has weak impact on metacognitive learning strategies.

According to Cohen's (1988) assertion, Effect size of 0.02, 0.15, and 0.35 indicates small, medium, and large effect, respectively. Therefore, from table 4.8, f^2 = 0.033 implies that there is a weak effect of academic self-efficacy on academic performance in chemistry.

4.2.4 Hypothesis Four

H_0: Metacognitive learning strategies mediate the relationship between academic self-efficacy and academic performance.

Mediation analysis was performed to assess the mediating effect of Metacognitive Learning Strategy (MLS) on the connectivity between Academic Self-Efficacy (ASF) and Academic Performance (AP) of students in Chemistry. The results (Table 4.9) revealed that the total effect of Academic Self-Efficacy on Academic Performance was significant (β =0.199, t = 1.284, p = 0.020). With the inclusion of Metacognitive Learning, the effect of Academic Self-Efficacy on Academic Performance became insignificant (β = 0.169, t = 0.873, p =0.393). The indirect effect of Academic Self-Efficacy on Academic Performance through Metacognitive Learning was equally found insignificant (β = -0.031, t =0.222, p= 0.824). This shows that the relationship between Academic Self-Efficacy and Academic Performance has no mediation by Metacognitive Learning.

STable 4.7: R-Squared value and P value.

Construct	R^2	Communality (AVE)	D. G rho
Academic Self-Efficacy		0.324	**0.700**
Metacognitive Learning Strategy	0.191	0.156	**0.477**
Academic Performance	0.032	1.000	**1.000**
Average	**0.112**	**1.48**	**0.726**

Table 4.8: Path Coefficient and F-Squared Values

Construct (Path Coefficient & f^2)	Academic Self-Efficacy	Metacognitive Learning Strategy	Academic Performance
Academic Self-Efficacy		0.437 .236	**0.199** **.033**
Metacognitive Learning Strategy			**-0.070** **.004**

Table 4.9. Mediation Analysis

Total Effect		Direct Effect			Indirect Effect				
Coefficient	P Value	Coefficient	P Value		Coefficient	SD	T values	P Values	BI
0.199	0.020	0.169	0.393	ASF-MLS-AP	-0.031	0 .137	0.222	0.824	-0.362 – 0.162

CONCLUSION

In conclusion, our conceptual theoretical model explains the consequences of academic self-efficacy, metacognitive learning strategies on academic performance. Our results revealed that the students who believed in their abilities used more metacognitive learning strategies and thus resulted in better academic performance.

RECOMMENDATIONS

Chemistry teachers in colleges of education can reduce the students' stress by providing a supportive and calm environments as this can influence the students' self-efficacy. Positive feedbacks should be encouraged in the classroom by creating interactive approaches and cooperation and participation in class discussions.

Results of the study also suggest that chemistry teachers should take measures in order to create a peaceful environment where the students feel comfortable and secure since positive feeling toward the learning environment can increase positive attitude like enjoyment, pride, and hope in the students while learning and thus leads to academic success.

In addition, creating an atmosphere in which the students experience freedom and respect would make them enjoy the presence of their teacher in the class and in turn leads to involvement in teaching, more academic engagement, and the use of deeper learning strategies. Moreover, some factors can influence academic self-efficacy indirectly. For instance, the quality of teaching in the classroom can directly influence the students' perceived academic control and self-efficacy. Thus, behavior in the class, positive feeling and the teachers' quality of teaching can influence the students' learning which, in turn, can be a significant factor inraising the students' metacognition and self-efficacy.

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