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Path Analysis of the Impact of Students' Learning Strategies Use on Achievement and Metacognition in Chemistry

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Abstract

This paper analyses the relationship between students' learning strategies use, achievement, and metacognition using path analysis. Five specific objectives guided this study. The sample consists of 421 Senior Secondary 11 chemistry students from nine public schools in Lagos State, Nigeria. Process Oriented Cooperative-Inquiry Learning Strategic Instruction Method (POCILSIM) was used to give learning strategies intervention to the students. Learning Strategies Scale (LSS), Chemistry Achievement Test (CAT), and Metacognition Learning Inventory–Chemistry (MLI-C) were used to collect data. SPSS and AMOS 26 were employed to calculate the path coefficient and goodness of fit statistics. Findings show that Learning strategies have a significant positive correlation with students' achievement and metacognition though, the strength of the relationship is low for achievement. The result shows that metacognitive self-regulation skill has the highest correlation while effort regulation strategy has less correlation with the variables. The conclusion is that learning strategies intervention improves the students' achievement and metacognition in chemistry which will directly improve the standard and quality of the country's workforce and economy. As a recommendation, the policymakers should approve the inclusion and teaching of learning strategies using POCILSIM in the national curriculum at all levels.

Keywords:
Achievement, Learning Strategies, Metacognition, Socioeconomic status, POCILSIM

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Background to the Study

Chemistry is one of the central science subjects for medical sciences, textile technology, agricultural science, synthetic industry, printing technology, pharmaceutical and chemical engineering. However, many students perceive chemistry as difficult due to its abstract nature, poor examples of everyday life, and teachers' ineffective instructional methods that lack students' engagement in the classroom (Gunuc 2014). Academic achievement is the final grade that students get after a systematic and comprehensive measurement and evaluation of the students in a school setting to make decisions or judgments on their cognitive, affective, and psychomotor domains (Ahmodu, Adaramaja and Adeyemi, 2018). According to the authors, the method of measuring students' academic achievement in school is the result of understudies in open assessments, which are used to pass judgment on the schools and the teachers. In Nigeria, Nuze (2011) reported that there was a general worry about the poor quality of education outputs at all levels, the study specifically reported that the educational system in Nigeria was far from achieving the desired educational goals and objectives as there was noticeable evidence of a decline in the standard and quality of students, especially at the secondary school level. The standard and quality of students' academic achievement and the examination of the factors relating to academic achievement are the topics of concern at different educational levels. The studies carried out on low achievement in chemistry showed that the teaching method is one of the major causes of low achievement in chemistry (Offiah and Akusoba, 2009). Obrentz, (2012) posited that awareness of the variables that predict academic achievement allows for shaping instructional delivery and designing support programs that foster students' success.

There is widespread agreement that the education systems are failing to adequately equip all students with the appropriate 21st Century knowledge and skills necessary to succeed in life. Chalkiadaki (2018, 5) states that 21st Century Skills are a broad range of skills and professional attributes, including creativity, divergent thinking, critical thinking, teamwork, work autonomy, cognitive and interpersonal skills, social and civic competencies, responsible national and global citizenship, a consciousness of interdependence, acceptance, and understanding of diversity, recognition, and development of personal attributes, interactive use of tools and communication skill, mathematical and science competence, digital competence, sense of initiative and entrepreneurship, accountability, leadership, cultural awareness, and expression. Thus, the 21st Century learning skills emphasize the importance of learning strategies (critical thinking, social skills, self-regulation, and executive functioning) in the education program which prepare the students for lifelong learning. It is on these premises that this present study investigated the impact of learning strategies use on students' achievement, and metacognition in chemistry.

Learning strategies are essential for science learning because they assist students in mastering the foundation knowledge necessary for advancing within the discipline (Miyake et al., 2010). Students are expected to not only understand concepts but also apply content to problem-solving and scientific inquiry (Taasoobshirazi and Glynn, 2009). Using strategies that develop and encourage scientific ability helps students in their college science courses and prepare them to solve real-life problems and tasks (Bao et al., 2009). Protheroe and Clarke (2008) posited that:

> *In schools and classrooms across the country, educators are working to raise the achievement of all students to ever-higher levels. Yet, often missing in discussions about how to raise academic performance is how individual students go about learning. One aspect of a student's approach to learning is his or her use of learning strategies*

According to cognitive psychologists such as Jean Piaget and Bruner Jerome believe that for learning to take place there must be an internal mental change unlike the behaviorists such as John Watson and B.F Skinner who emphasize external behavior change, learning involves the formation of mental representations or associations. Thus, learning strategies are a series conscious behaviors, thoughts, and actions that the learner displays during learning to affect the encoding process (Ormrod, 2015). There are several cognitive learning strategies that affect long-term memory storage including selection, rehearsal, meaningful learning, elaboration, organization, and visual imagery (Ormrod, 2015). Also, Stumm and Furnham (2012) asserted that learning strategies are a collection of cognitive and behavioral processes and abilities that influence how information is acquired, maintained, and recalled. The authors stated that students could use strategies such as rehearsal, organization, elaboration, critical thinking, metacognitive self-regulation skills, effort regulation, time, and study environment management, help-seeking, and peer learning (720-723). The nine learning strategies were considered in this study:

Rehearsal involves identifying and repeating important segments of the given material. Memorizing, loud-reading, listing concepts, highlighting, underlining, and using mnemonics are examples. Elaboration involves paraphrasing information, summarizing, matching, applying analogies, generating metaphors; making comparisons, writing questions, and forming mental images. Organization involves reviewing and restructuring the presented materials by outlining, creating tables, classifying, re-grouping, connecting pieces, and generating concept maps. Critical Thinking is a higher-order learning strategy, it involves applying learned information to the knowledge of new situations. Relating subject matter to be learned to one's prior knowledge. Metacognitive Self-Regulation Skill involves learners' awareness and knowledge of their cognitive processes. The student evaluates his/her performance and comes up with better ways of learning. Students take responsibility of their learning through personal reflection, self-critiquing and changing their study habits. Time and Study Environment Management is choosing appropriate environments that are conducive to learning; that is free from distractions and effectively planning, and managing one's study time. Effort Regulation is the effort a student employs to reach his or her learning goals. It enhances the learner's ability to handle issues of setbacks and failures that may arise during the learning process by applying the required effort to increase successful learning. Peer Learning involves studying with peers (friends, classmates, etc.) to collaboratively understand course material or information to be learned. Help-Seeking is an adaptive learning strategy that allows a learner to optimize learning by seeking help from human and material resources such as subject teachers, peers, relevant textbooks, or the internet. There may be many strategies as the number of students because each student selects and employs a different strategy depending upon instructional variables such as individual differences, types of domains; teaching methods; the amount of time, learning technologies, kinds of feedback, required level of mastery and ways of measurement.

Students can use the skills of metacognition to know when, where, and how to construct textual meanings which serve to further enhance learning. Flavell (1985) posits that metacognition is knowledge and cognition on the cognitive manifestation and one's knowledge on self-cognitive processes and how the knowledge is used to monitor the cognitive processes. Metacognition can generally be defined as "cognition about cognition" or "thinking about thinking" and includes metacognitive information that controls the knowledge of human cognitive activities and metacognitive activities (Schunk, 2008). According to Medina (2008), metacognition is important to every profession. In education, metacognition guides learning strategies use in the learning process. However, there are certain difficulties experienced in the transmission of knowledge and skills through the process of metacognition. In their definition of metacognition; Paris and Winograd (1990) 'captures two essential features: self-appraisal and self-management of cognition'. Self-appraisals are people's reflections on their knowledge states and abilities, and their affective states concerning their knowledge, abilities, motivation, and characteristics as learners. Such reflections answer questions about 'what you know, how you think, and when and why to apply knowledge strategies' (Paris and Winograd, 1990, 17). Self-management refers to 'metacognition in action', that is, mental processes that help to 'orchestrate aspects of problem-solving, the plans that learners make before tackling a task', 'the adjustments they make as they work', and 'the revisions they make afterward' (18). Thus, metacognition is awareness and management of one's thoughts (Kuhn and Dean, 2004, Boroch, et al., 2010).

Metacognition consists of two components: metacognitive knowledge and metacognitive regulation. Metacognitive knowledge is the knowledge about an individual's cognition as a learner and how, when, and why to apply certain strategies that improve performance. This involves three factors that include (1) declarative knowledge which refers to the individual's knowledge about their own beliefs and perception of task structure. (2) procedural knowledge which means the knowledge about the execution of procedural skills (Lai, 2011), and (3) conditional knowledge which is knowing when and why to apply various cognitive actions (Lai, 2011), Metacognitive regulation contains three regulatory skills comprising planning, monitoring and evaluating (Balcikanli,2011). Planning indicates choosing appropriate strategies and resources. Monitoring is an individual's awareness of comprehension and task performance. Evaluating means judgment of outcomes and effectiveness of the regulation process when matched with the task goals. Metacognitive knowledge and skill development start at a young age in individuals, through experience, teachers' method of instruction by scaffolding, and modeling, giving students ample opportunities to practice only then students can develop into competent metacognitive adults. The integration of metacognition in classroom instruction is to enhance students' metacognitive knowledge, metacognitive skills, and acquire a habit of using metacognition in learning (Peteranetz, 2016).

Socioeconomic status (SES) is a person's economic standing based on lifestyle, prestige, power, and control of resources (Korb, 2012). In this present study, socioeconomic status refers to the level of a family's economic and social position based on education, occupation, and income. Stewart (2008) asserted that students from high socioeconomic status families are likely to achieve high academic goals. The academic progress of students in school is influenced by the motivation they get from home; putting them in better schools, buying them all the necessary school materials, properly feeding them, providing home amenities that will facilitate learning, e.g., library, part-time teachers to teach them after school (Nwachukwu, 2011). Ajayi and Muraina (2011) also identify socioeconomic status as one of the determinants of students' achievement. Hence, this study is to analyze the relationship between students' learning strategies use, academic achievement, and, metacognition in chemistry and also examined the influence of socioeconomic status (SES) on these variables to build on the previous studies' findings.

Concept of Path Analysis

Sewell Wright, a geneticist developed Path analysis in the 1920s to investigate the effects of hypothesized models in phylogenetic studies. According to him, the path analytic method was to measure the direct effect along each separate path in such a system and find the degree to which variation of a given effect is determined by each particular cause. Path analysis is an extension of regression model which researchers use to test the fit of a correlation matrix with a causal model that they test (Garson, 2004). Path analysis gives the estimates of the magnitude and significance of hypothesized causal connections among sets of variables through the path diagrams. A path diagram illustrates how the variables are identified and arrows from variables are drawn to other variables to indicate theoretically based causal relationships. Path analysis compelled the researcher to state how the variables relate to one another and thus promotes the development of clear and logical theories on the process influencing a particular outcome (McWayne, 2004).

Concept of POCILSIM

According to Darling-Hammond, et al (2008) learners are expected to self-manage their learning process but a majority of students lack this ability. In view of this, teachers can guide the students by teaching the learning strategies as part of content-area instruction through learning strategy intervention using Process Oriented Cooperative-Inquiry Learning Strategic Instruction Method developed by this study researcher.

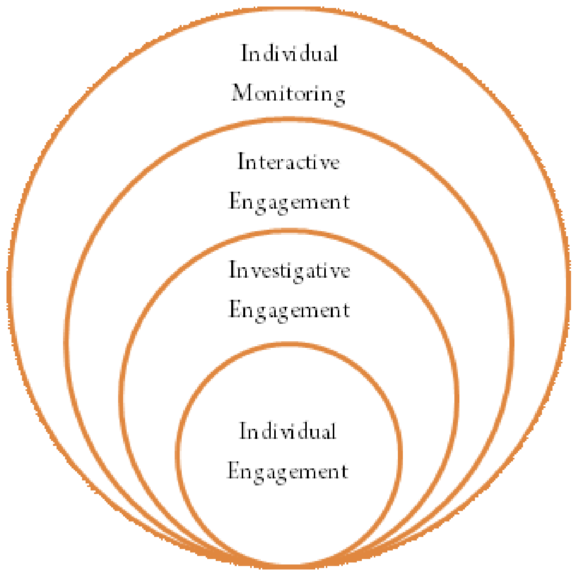


Fig 1: POCILSIM Learning Cycle Model - The 4i's

POCILSIM Classroom

The class is divided into small groups of 6-7 students who must learn a joint topic referred to as a learning task. The task is divided into sub-units of similar size and responsibility. Each of these is assigned to one of the students in the group beforehand. The sub-units are independent of each other, so each of the group members can learn about it individually using rehearsal, help-seeking, time, and study management strategies (Independent Engagement). After being familiar with their piece of information the students from all groups with responsibility for the same sub-unit are grouped (adept round). The adept groups continue working on their topic as a group to produce an explanation on their topic which they will share with other students using peer-learning, elaboration, organization; critical thinking, time, and study environment management (Investigative Engagement).The students then return to their starting groups; to teach and learn from each other about the different pieces of the whole topic (proficient round) using peer learning, help-seeking, critical thinking, effort regulation, time, and study environment management (Interactive Engagement). While the process of students' inquiry is ongoing, the teacher acts as facilitator and collaborator. After the group discussion, each group gives a presentation, report, and other contributions to the whole class while the other students listen and ask questions already formulated on the topic. Each group then self-critiques their work on why they use certain strategies; why they performed well and also performed poorly in some areas using metacognitive self-regulation skills, Time, and study environment management (Individual monitoring). The students during the discussion and presentation stage have the opportunities to speak, share ideas, evaluate their ideas, and appreciate other students' opinions when they are working in a small group. The results of all the groups are then criticized generally and evaluated by both the students and the teacher.

Fig. 2: Students Working in Small Groups During the Field Study

The chemistry practical starts with a learning task consisting of four steps: observation and comprehension of the macroscopic nature of matters, concept formulation, application, and evaluation based on Bloom's Taxonomy of Educational Objectives for Skills-Based Goals. Conceptual understanding in chemistry is the ability to explain chemical phenomena at the three levels of representation: macroscopic, microscopic, and symbolic levels. The inability to explain chemical phenomena at the three levels of representation: macroscopic, microscopic, and symbolic state by the students may account for their poor performance. When relationships are formed between these three levels of representation, students understand chemistry meaningfully (Sanger, Phelps, and Fienhold., 2000). The observation and comprehension step is to train students on how to carry out observation, write observation results, interpret, and extrapolate the results. The concept and question formulation is to enhance students' critical thinking in which he or she formulates concepts and questions based on observation results. The application involves using the formulated concepts to solve non-routine problems to enhance students' problem-solving skills. During the evaluation, the students critique the observation result. The students need to be trained on how to formulate concepts and questions. Chemistry education is aimed at developing factual, conceptual, procedural, and metacognitive knowledge, so providing tasks for concept formulation and concept application is very important.

Statement of the Problem

Many studies had been carried out on how to improve students' achievement in chemistry but there is still a need for further research on students' achievement and metacognitive skill acquisition in chemistry because there is still a large gap in our knowledge in terms of most 21st century skills such as creativity, critical thinking, learning skills, socio-communicative skills, and self-management skills. Memorizing facts and processes is not enough for academic success. An educated worker needs a conceptual understanding of complex concepts, and the ability to work creatively to generate new ideas, theories, products, and knowledge, be able to critically evaluate what they read, express themselves clearly both verbally and in writing, and develop scientific and mathematical thinking. They need to take responsibility for their life-long learning. The 21st Century learning skills emphasize the importance of learning strategies (critical thinking, social skills, self-regulation, and executive functioning) in the education program which prepare the students for lifelong learning but the literature reviewed showed less attention to the impact of learning strategies use on academic achievement of secondary school students. Some studies (Komarraju and Nadler, 2013; Kassab et al. 2015., Lee, Makara, Fishman, and Teasley, 2017) investigated the effects of learning strategies on students' achievement in chemistry but were done outside Nigeria. In Nigeria, Anyachie and Anyodike (2012) investigated the effects of self-instructional learning strategy on secondary school students' academic achievement but there is no research on the impact of students' learning strategies use on their metacognition. It is on these premises that this present study aims at investigating the impact of learning strategies (rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation skill, time, and study management, effort regulation, peer learning, and help-seeking) on students' academic achievement and metacognition in chemistry at secondary school level.

Objectives of the Study

This study aim is to examine the impact of students' learning strategies use on students' academic achievement and metacognition in chemistry using path analysis. The study also examined the influence of socioeconomic status (SES) on students' learning strategies use, academic achievement and metacognition in chemistry. The Specific objectives are to:

1. Investigate the relationship between students learning Strategies use and their academic achievement in chemistry.
2. Investigate the relationship between students learning Strategies use and their metacognition in chemistry.
3. Examine learning strategies use among chemistry students concerning their socio-economic status (very high, high, average and low).
4. Examine academic achievement among chemistry students concerning their socio-economic status (very high, high, average and low).
5. Examine metacognition among chemistry students concerning their socioeconomic status (very high, high, average and low).

Hypotheses of the Study

1. There is no significant relationship between students' learning Strategies use and their academic achievement in chemistry.
2. There is no significant relationship between students' learning Strategies use and their metacognition in chemistry.
3. There is no significant difference in learning strategies use of chemistry students based on their socio-economic status (very high. High, average, and low).
4. There is no significant difference in academic achievement of chemistry students based on their socio-economic status (very high, high, average, and low).
5. There is no significant difference in metacognition of chemistry students based on their socio-economic status (very high, high, average and low).

Literature Review

It is important to note that although a great number of past studies examined the relationship between learning strategies and academic achievement, there is inconsistency in the results. Simsek and Balaban (2010) investigated learning strategies at Anadolu University in Turkey. The study is on the most commonly used learning strategies of undergraduate students in relation to their academic achievement. Using a correlational research design and a sample of 278 undergraduate students, correlations were conducted among rehearsal, elaboration, and organization learning strategies. Results revealed a significant positive correlation between the learning strategies and academic achievement. Most students used more elaboration and organization learning strategies than rehearsal learning strategies. Chan Lin (2012) found that the relationship between effort regulation and academic performance is not significant. Hamid and Singaram (2016) noted in their research that learning strategies: critical thinking and time, and study environment management were significantly poorly correlated to the academic performance of medical students. In contrast, some studies have found that effort regulation is important in facilitating academic performance (Kassab et al., 2015; Komarraju and Nadler, 2013). In Nigeria, Anyachie and Anyodike (2012) investigated the effects of self-instructional learning strategy on secondary school students' academic achievement. Using a quasi-experimental research design and a sample of 131 (66 females, 65 males) secondary school students, the study found that self-instructional strategy increased students' problem-solving skills that result in high academic achievement.

Ngozi (2009), carried out a quasi-experimental design on metacognitive strategies using three intact groups, two treatment groups (think-pair-share and metacognitive strategies), and a control group. Results revealed that metacognitive strategies are more effective in enhancing academic achievement followed by think-pair-share. Lee, Makara, Fishman, and Teasly (2017) explored how the relationship between college students' learning strategies and their grade point average differs across culturally different institutions. Using a survey, a sample of 621 students at a South Korean University and 824 students at a university in the USA were assessed on Motivation related, assignment task-related, planning/time-related, and cognition-related strategies. Specifically, the cognition-related strategies were rehearsal learning strategy, elaboration learning strategy, and organization learning strategy. Hierarchical multiple regression was performed to determine the predictive power of the four factors on students' GPA at each University. Results revealed that the cognition-related factors (rehearsal learning strategy, elaboration learning, and organization learning strategy) were the strongest predictors of GPA for Korean students, but it was unrelated to the USA students.

Scanlon, (2012) posits that metacognition is individual's ability to use prior knowledge to plan a strategy for carrying out a learning task, take appropriate steps to solve a problem, reflect on and evaluate the results, and modify one's approach as necessary. It helps learners to use the right cognitive tool for the task and plays a critical role in successful learning. Some researchers claim metacognition is one of the most important learning skills of the 21st century, relevant in the educational and psychological context (Muawiyah, Yamtinah, and Indriyanti, 2019). Kuiper (2002) asserts that people who are aware of how they learn do achieve better academic performances and that metacognition stimulates and nurtures reflective thinking, accord responsibility, builds self-confidence to make effective decisions, and enables the development of critical and creative thinking. Research indicates that metacognition is a powerful predictor of learning success and academic achievement (Dunning et al., 2003). Students having mastery goals are found to have good metacognition and are better learners than students with performance goals (Coutinho, 2007). Kemal (2010) affirms that metacognition and learning strategies are important factors in the academic success of a student and that metacognition is a positive predictor of academic success. Shetty (2014) found that student teachers with introversion learning styles and thinking were found to have a higher metacognition compared to student teachers with the extraversion learning styles and feeling. Corbitt (2017) found that the learning style of students (foreign language program) specifically the visual learning style significantly affect the planning and evaluation components of metacognition of students.

Iqbal et al. (2019) posits that medical students have higher levels of metacognitive abilities, high skills of metacognition, and better academic achievement than nonmedical or other professional students. Narang and Saini (2013) investigated the effects of metacognition on the academic performance of 240 rural school students. The authors inferred that the students with high metacognitive levels scored above average in terms of academic performance and conclude that the components of metacognition: cognition knowledge and cognition regulation, significantly contributed to students' academic achievement. Metacognition awareness is the ability to reflect on how to think and use problem-solving skills in dealing with learning difficulties (Joseph, 2010). Young and Fry (2008) conducted a study to test the metacognitive awareness of students with GPA measured at the beginning of the semester and at the final semester. The results show that there are significant differences in the two results, this was because towards the end of the semester students have already learnt, master and capable of using metacognitive awareness well through learning strategies intervention.

Karnel (2001) and Teese (2004), study shows that students whose parents are employed in professional occupations (higher socioeconomic status) had the highest average scores, and students whose parents were production workers or laborers (lower socioeconomic status) had the lowest. Rothman (2004), showed that the most important factor associated with the educational achievement of children is socioeconomic factors. These factors according to him include parental educational levels, neighbourhood poverty, parental occupational status, and family income. Krashen (2005) posited that students whose parents are highly educated had good grades on standardized tests than students whose parents are not educated.

Methodology

Correlation survey research design was used to establish the relationship among the variables of the study using path analysis. A Single-case experimental design was used to give treatment (Intervention) to students on learning strategies. The population of the study consist of all Senior Secondary School II Chemistry students from three Education district in Lagos State of Nigeria. Simple random sampling technique was used to select nine public schools from the three Education district. The sample consists of intact classes made up of four hundred and twenty-one (421) students with average age of 15 years. The instruments used to collect data are Learning Strategy Scale (LSS), a 50-item with 9 subscales (Cronbach alpha reliabilities ranged from .55 to .87), Metacognition Learning Inventory–Chemistry (MLI-C), a 24-items (Cronbach's – Alpha scores (0.68 to 0.85)) and Chemistry Achievement Test (CAT), a-40 item. Face, content and construct validation were employed to determine the validity of the items, the appropriateness and relevance of the instruments to the research study by two senior chemistry teachers. Reliability of the CAT was done by test-retest and Pearson Moment Correlation Coefficient, .86. Learning strategies intervention was administered to the students during chemistry instruction using Process Oriented Cooperative-Inquiry Learning Strategic Instruction Method (POCILSIM). The learning strategies Scale (LSS) and the Metacognition Learning Inventory–Chemistry (MLI-C) were administered at three intervals (Pre-, Post and Delayed Post) to measure the students learning strategies use and metacognition respectively. The Chemistry Achievement Test (CAT) was administered twice during the study as pre-test and post-test to measure the students' achievement which lasted for twelve (12) weeks. The chemistry teachers from the nine selected schools were used as research assistants for the study and were given certificate of participation at the end of the exercise as incentive. The research assistance were trained for three weeks on teaching learning strategies in the context of their subject using Process Oriented Cooperative-Inquiry Learning Strategic Instruction Method (POCILSIM).The statistical tools used for the analyses of data collected were chi-square and t-test. SPSS and AMOS 26 software program was employed to calculate the path coefficient and goodness of fit statistics automatically.

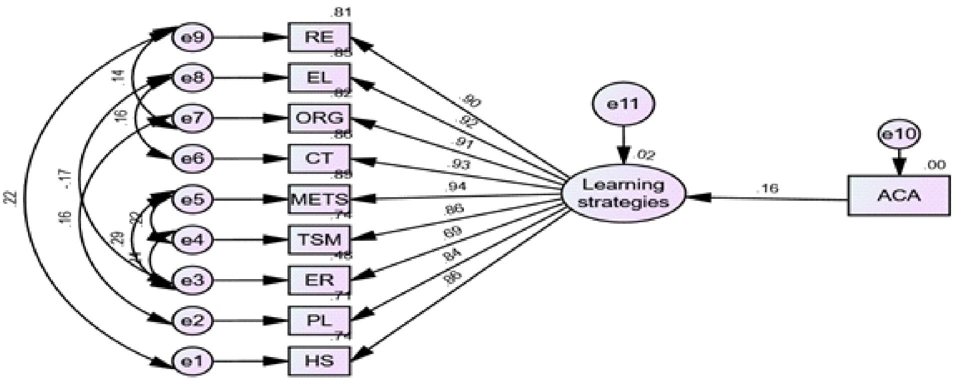
Results

The analysis of the dataset was carried out using IBM SPSS Statistics to code the data, IBM SPSS Amos v26 for the path analysis. The data was first code into IBM SPSS Statistics v26 and imported the file into IBM SPSS Amos v26 to design path analysis and then use the data fields to answer the research questions. The evaluation metrics used are Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), Tucker-Lewis Index (TLI), Confirmation Factor Analysis (CFA), Goodness-of Fit Index (GFI), and Average Goodness-of Fit Index (AGFI). The recommended cut-offs used are GFI (0.95), TLI (0.95), CFI (0.95) and RMSEA (0.06) by Hu and Bentler (1999). In general, the acceptable cut-offs for RMSEA < 0.08 while GFI, AGFI, TLI and CFI should be greater than 0.90. Moreover, it is important to note that chi-square is sensitive to large data size and can skewed data.

Hypothesis 1

There is no significant relationship between students' learning Strategies use and their academic achievement in chemistry.

Figure 3: Causal model for learning strategies on achievement in chemistry.



On the causal model of learning strategies on achievement in chemistry, the observed endogenous variables are (HS, PL, ER, TSM, METS, CT, ORG, EL, RE, ACA), the unobserved endogenous variable is (Learning strategies) while the unobserved exogenous variables are (e1, e2, e3, e4, e5, e6, e7, e8, e9, e10, e11) as indicated in figure1. The tabulated path estimate is given in table 1. The standard regression weights on learning strategies and achievement is (0.156), the weight for the individual learning strategy shows that Metacognition Self-regulation Skill is (0.941), Critical Thinking (0.927), Elaboration (0.923), and Rehearsal (0.899) as shown in Table 2. This means that metacognition self-regulation skill has the highest impact on students' academic achievement followed by critical thinking.

Table 1: Regression Weights: Learning strategies on academic achievement

			Estimate	S.E.	C.R.	P	Label
Learning_strategies	<---	ACA	.161	.051	3.164	.002	
HS	<---	Learning_strategies	1.000				
PL	<---	Learning_strategies	.789	.034	22.890	***	
ER	<---	Learning_strategies	.761	.046	16.590	***	
TSM	<---	Learning_strategies	1.683	.071	23.763	***	
METS	<---	Learning_strategies	2.911	.101	28.780	***	
CT	<---	Learning_strategies	1.404	.051	27.771	***	
ORG	<---	Learning_strategies	1.217	.046	26.523	***	
EL	<---	Learning_strategies	1.724	.063	27.518	***	
RE	<---	Learning_strategies	1.246	.042	29.450	***	

In table 1, the paths ACA → Learning strategies and the path of each Learning strategies (RE, EL, ORG, CT, METS, TSM, ER and PL) are all statistically significant at p-value < .001. Learning strategies → HS is set as the standardized path.

Table 2: Standardized Regression Weights: Learning strategies on achievement in chemistry

			Estimate
Learning strategies	<---	Achievement	.156
HS	<---	Learning strategies	.860
PL	<---	Learning strategies	.841
ER	<---	Learning strategies	.692
TSM	<---	Learning strategies	.859
METS	<---	Learning strategies	.941
CT	<---	Learning strategies	.927
ORG	<---	Learning strategies	.907
EL	<---	Learning strategies	.923
RE	<---	Learning strategies	.899

Table 3: Squared Multiple Correlations: Learning strategies on achievement in chemistry (Zero Order Correlation)

	Estimate
Achievement	.000
Learning strategies	.024
RE	.809
EL	.853
ORG	.822
CT	.860
METS	.886
TSM	.738
ER	.479
PL	.707
HS	.739

In table 3, The zero-order correlation on learning strategies is (0.024). The learning strategy with the highest correlation with achievement is Metacognition Self-regulation Skill (0.886) followed by Critical Thinking (0.860) and then Elaboration (0.853). This confirms that Metacognition Self-regulation Skill has the highest impact on students' academic achievement

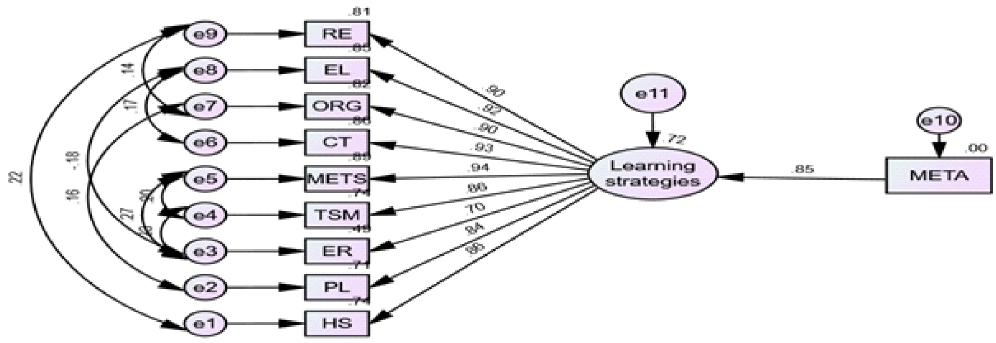
Table 4: Model Fit Summary of Learning strategies on achievement

Fit Indices	χ2	df	p-value	χ2 /df	GFI	AGFI	CFI	NFI	RMSEA	PCLOSE
Model value	46.054	27	.013	1.706	0.979	0.990	0.996	0.997	0.041	0.754

In table 4, the model fit summary is given as Chi-square = 46.054, df = 27, p-value = .013 shows that the Chi-square test is statistically significant, Chi-square/df = 1.706 meets the recommended value < 5 Bentler (1989), GFI = .979, AGFI = .958, NFI = .990, CFI = .996, RMSEA = .041 (adequate fit satisfied), PCLOSE = .754 means a good model fit. The probability value of .754 shows there is no statistically significant difference between the observed RMSEA and an RMSEA less than or equal .05. Hence, the null hypothesis 1 is rejected

Hypothesis 2
There is no significant relationship between students' learning Strategies and their metacognition.

Figure 4: Causal model for learning strategies on metacognition in chemistry.



On the causal model for learning strategies on metacognition in chemistry, the observed endogenous variables are (HS, PL, ER, TSM, METS, CT, ORG, EL, RE, META), the unobserved endogenous variable is (Learning strategies) while the unobserved exogenous variables are (e1, e2, e3, e4, e5, e6, e7, e8, e9, e10, e11) as display in figure 4. The paths are tabulated in table 5. The zero-order correlation on learning strategies (0.719) is given in table 7, while the correlation for the individual learning strategy shows that Metacognition Self-regulation Skill is (0.890) followed by Critical Thinking (0.857) and Elaboration (0.850).

Table 5: Regression Weights: Learning strategies on metacognition

			Estimate	S.E.	C.R.	P	Label
Learning_strategies	<---	META	.226	.010	23.244	***	
HS	<---	Learning_strategies	1.000				
PL	<---	Learning_strategies	.793	.035	22.950	***	
ER	<---	Learning_strategies	.769	.046	16.803	***	
TSM	<---	Learning_strategies	1.691	.071	23.825	***	
METS	<---	Learning_strategies	2.924	.102	28.796	***	
CT	<---	Learning_strategies	1.405	.051	27.610	***	
ORG	<---	Learning_strategies	1.217	.046	26.303	***	
EL	<---	Learning_strategies	1.726	.063	27.362	***	
RE	<---	Learning_strategies	1.250	.042	29.441	***	

In table 5, the paths META → Learning strategies, Learning strategies → RE, Learning strategies → EL, Learning strategies → ORG, Learning strategies → CT, Learning strategies → METS, Learning strategies → TMS, Learning strategies → ER, and Learning strategies → PL are all statistically significant at p-value < .001. Learning strategies → HS is the standardized path.

Table 6: Standardized Regression Weights of Learning strategies on metacognition

			Estimate
Learning strategies	<---	META	.848
HS	<---	Learning strategies	.857
PL	<---	Learning strategies	.843
ER	<---	Learning strategies	.697
TSM	<---	Learning strategies	.861
METS	<---	Learning strategies	.943
CT	<---	Learning strategies	.926
ORG	<---	Learning strategies	.905
EL	<---	Learning strategies	.922
RE	<---	Learning strategies	.900

Table 7: Squared Multiple Correlations of Learning strategies on metacognition (Zero Order Correlation) aaaaaaaaaaa`assss`ssaa

	Estimate
META	.000
Learning strategies	.719
RE	.810
EL	.850
ORG	.818
CT	.857
METS	.890
TSM	.742
ER	.486
PL	.711
HS	.735

Table 8: Model Fit Summary of Learning strategies on metacognition

Fit Indices	$\chi 2$	df	p-value	$\chi 2$ /df	GFI	AGFI	NFI	CFI	RMSEA	PCLOSE
Model value	44.205	27	.020	1.637	0.979	0.958	0.991	0.997	0.039	0.802

Table 8 shows the model fit summary Chi-square = 44.205, df = 27, p-value = .020 shows that the Chi-square test is statistically significant, Chi-square/df = 1.637 meets the recommended value < 5 Bentler (1989), GFI = .979, AGFI = .958, NFI = .991, CFI = .997, RMSEA = .039 (adequate fit satisfied), PCLOSE = .802 means a good model fit. The probability value of .802 shows there is no statistically significant difference between the observed RMSEA and an RMSEA less than or equal .05. Hence, the null hypothesis 2 is rejected

Hypothesis 3

There is no significant difference in learning strategies use of chemistry students based on their socioeconomic status (very high. High, average, and low).

Table 9: Pairwise t-test results for socioeconomic status on learning strategies

POST HOC TESTS - LSR

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
LSR	SES	Low	Moderate	FALSE	TRUE	-1.297	237	two-tail	0.196	0.265	-0.142
LSR	SES	Low	High	FALSE	TRUE	-1.193	15	two-tail	0.251	0.484	-0.348
LSR	SES	Low	Very High	FALSE	TRUE	-10.103	6	two-tail	0.000	1.026x1017	-1.471
LSR	SES	Moderate	High	FALSE	TRUE	-0.678	17	two-tail	0.507	0.332	-0.190
LSR	SES	Moderate	Very High	FALSE	TRUE	-8.147	9	two-tail	0.000	1.104x1010	-1.243
LSR	SES	High	Very High	FALSE	TRUE	-3.524	18	two-tail	0.002	14.053	-1.076

In table 9, Low -Very High socioeconomic status component for learning strategies has p-unc = 0.000 (having a significance level .000 doesn't mean that the level of significance is absolutely zero. It means that the number can't be anything larger than .0004, if is larger than that it would round up to .001) and BF10 = 1.026x1017 means, there is decisive evidence for H1 (significant evidence). The Moderate –Very High socioeconomic status component for learning strategies has p-unc = 0.000 and BF10 = 1.104x1010 means, there is decisive evidence for H1 (significant difference) between Moderate – Very High component on learning strategies. Finally, High – Very High socioeconomic status component has p-unc = 0.002 and BF10 = 14.053 means, there is strong evidence for H1 (significant difference). Hence, the null hypothesis is rejected

Table 10: Pairwise t-test results for socioeconomic status on each learning strategy
POST HOC TESTS - RE

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
RE	SES	Low	Moderate	FALSE	TRUE	-1.139	238	two-tail	0.256	0.220	-0.124
RE	SES	Low	High	FALSE	TRUE	-0.875	15	two-tail	0.395	0.368	-0.272
RE	SES	Low	Very High	FALSE	TRUE	-5.359	5	two-tail	0.004	39740	-1.199
RE	SES	Moderate	High	FALSE	TRUE	-0.459	17	two-tail	0.652	0.299	-0.137
RE	SES	Moderate	Very High	FALSE	TRUE	-4.560	6	two-tail	0.004	1021.169	-1.010
RE	SES	High	Very High	FALSE	TRUE	-2.447	17	two-tail	0.026	2.689	-0817

In table 10, Low –Very High socioeconomic status component for learning strategy (RE) has p-unc = 0.004 and BF10 =39740 means, there is decisive evidence for H1 (significant difference). In Moderate – Very High socioeconomic status component for learning strategy (RE), p-unc = 0.004 and BF10 = 1021.169 means, there is decisive evidence for H1 (significant evidence).

Table 11: Pairwise t-test results for socioeconomic status on learning strategy component
POST HOC TESTS - EL

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
EL	SES	Low	Moderate	FALSE	TRUE	-1.657	238	two-tail	0.099	0.440	-0.181
EL	SES	Low	High	FALSE	TRUE	-2.122	16	two-tail	0.050	1.764	-0.548
EL	SES	Low	Very High	FALSE	TRUE	-7.685	5	two-tail	0.000	9.801x109	-1.243
EL	SES	Moderate	High	FALSE	TRUE	-1.355	18	two-tail	0.192	0.585	-0.342
EL	SES	Moderate	Very High	FALSE	TRUE	-5.973	8	two-tail	0.000	286700	-0.996
EL	SES	High	Very High	FALSE	TRUE	-2.361	18	two-tail	0.030	2.394	-0.757

In Table 11, Low – Very High socioeconomic status component for learning strategy (EL) has p-unc = 0.000 and BF10 = 9.801x109 means, there is decisive evidence for H1 (significant difference). In Moderate – Very High socioeconomic status component for learning strategy (EL), p-unc = 0.000 and BF10 = 286700 means, there is decisive evidence for H1 (significant evidence).

Table 12: Pairwise t-test results for socio-economic status on learning strategy component POST HOC TESTS - ORG

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
ORG	SES	Low	Moderate	FALSE	TRUE	-1.205	240	two-tail	0.229	0.237	-0.131
ORG	SES	Low	High	FALSE	TRUE	-1.459	16	two-tail	0.164	0.650	0.360
ORG	SES	Low	Very High	FALSE	TRUE	-18.196	29	two-tail	0.000	8.735x1044	-1.389
ORG	SES	Moderate	High	FALSE	TRUE	-0.883	18	two-tail	0.388	0.378	-0.217
ORG	SES	Moderate	Very High	FALSE	TRUE	-12.096	68	two-tail	0.000	2.995x1019	-1.200
ORG	SES	High	Very High	FALSE	TRUE	-4.202	15	two-tail	0.001	45.272	-1.197

In table 12, Low – Very High socioeconomic status component for learning strategy (ORG) has p-unc = 0.000 and BF10 = 8.735x1044 means, there is decisive evidence for H1 (significant difference). In Moderate – Very High socio-economic status component for learning strategy (ORG), p-unc = 0.000 and BF10 = 2.995x1019 means, there is decisive evidence for H1 (significant evidence). In High – Very High, socio-economic status component for learning strategies (ORG) has p-unc = 0.001 and BF10 = 45.272 means, there is very strong evidence for H1 (significant difference).

Table 13: Pairwise t-test results for socioeconomic status on learning strategy component

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
CT	SES	Low	Moderate	FALSE	TRUE	-2.034	242	two-tail	0.043	0.856	-0.220
CT	SES	Low	High	FALSE	TRUE	-1.943	16	two-tail	0.070	1.298	-0.523
CT	SES	Low	Very High	FALSE	TRUE	-6.985	5	two-tail	0.001	1.59x108	-1.312
CT	SES	Moderate	High	FALSE	TRUE	-1.079	18	two-tail	0.295	0.443	-0.287
CT	SES	Moderate	Very High	FALSE	TRUE	-5.428	6	two-tail	0.001	28300	-1.044
CT	SES	High	Very High	FALSE	TRUE	-2.465	17	two-tail	0.024	2.757	-0.816

In table 13, Low – Very High socioeconomic status component for learning strategy (CT) has p-unc = 0.001 and BF10 = 1.59x108 means, there is decisive evidence for H1 (significant difference). In Moderate – Very High socioeconomic status component for learning strategy (CT), p-unc = 0.001 and BF10 = 28300 means, there is decisive evidence for H1 (significant evidence).

Table 14: Pairwise t-test results for socioeconomic status on learning strategy component POST HOC TESTS - METS

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
METS	SES	Low	Moderate	FALSE	TRUE	-1.341	242	two-tail	0.181	0.280	-0.145
METS	SES	Low	High	FALSE	TRUE	-1.107	15	two-tail	0.286	0.446	-0.331
METS	SES	Low	Very High	FALSE	TRUE	-7.231	5	two-tail	0.001	6.568x108	-1.317
METS	SES	Moderate	High	FALSE	TRUE	-0.603	17	two-tail	0.554	0.319	-0.177
METS	SES	Moderate	Very High	FALSE	TRUE	-6.000	7	two-tail	0.001	323000	-1.125
METS	SES	High	Very High	FALSE	TRUE	-2.858	18	two-tail	0.010	4.856	-0.911

In Table 14 the Low – Very High socioeconomic status component for learning strategy (METS) has p-unc = 0.001 and BF10 = 6.568x108 means, there is decisive evidence for H1 (significant difference). In Moderate – Very High socioeconomic status component for learning strategy (METS), p-unc = 0.001 and BF10 = 323000 means, there is decisive evidence for H1 (significant evidence). In High – Very High, the socioeconomic status for learning strategy (METS) has p-unc = 0.01 and BF10 = 4.856 means, there is substantial evidence for H1 (significant difference).

Table 15: Pairwise t-test results for socioeconomic status on learning strategy component
POST HOC TESTS - TSM

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
TSM	SES	Low	Moderate	FALSE	TRUE	0.071	241	two-tail	0.944	0.118	0.008
TSM	SES	Low	High	FALSE	TRUE	-0.811	15	two-tail	0.429	0.352	-0.223
TSM	SES	Low	Very High	FALSE	TRUE	-8.921	5	two-tail	0.000	2.723x1013	-1.419
TSM	SES	Moderate	High	FALSE	TRUE	-0.814	17	two-tail	0.429	0.361	-0.221
TSM	SES	Moderate	Very High	FALSE	TRUE	-8.217	8	two-tail	0.000	1.584x1010	-1.369
TSM	SES	High	Very High	FALSE	TRUE	-3.873	18	two-tail	0.001	25.497	-1.219

In Table 15, the Low –Very High socioeconomic status component for learning strategy (TSM) has p-unc = 0.000 and BF10 = 2.723x1013 means, there is decisive evidence for H1 (significant difference). In Moderate – Very High socioeconomic status component for learning strategy (TSM), p-unc = 0.000 and BF10 = 1.584x1010 means, there is decisive evidence for H1 (significant evidence). In High – Very High, the socioeconomic status for learning strategy (TSM) has p-unc = 0.001 and BF10 = 25.497 means, there is strong evidence for H1 (significant difference).

Table 16: Pairwise t-test results for socioeconomic status on learning strategy effort regulation
POST HOC TESTS - ER

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
ER	SES	Low	Moderate	FALSE	TRUE	-0.152	230	two-tail	0.879	0.119	-0.017
ER	SES	Low	High	FALSE	TRUE	-0.015	16	two-tail	0.988	0.268	-0.004
ER	SES	Low	Very High	FALSE	TRUE	-4.174	4	two-tail	0.011	348.375	-1.064
ER	SES	Moderate	High	FALSE	TRUE	0.052	19	two-tail	0.959	0.275	0.012
ER	SES	Moderate	Very High	FALSE	TRUE	-3.932	5	two-tail	0.010	128.047	-0.948
ER	SES	High	Very High	FALSE	TRUE	-3.047	12	two-tail	0.010	6.488	-1.160

In Table 16, the Low – Very High socioeconomic status component for learning strategy (ER) has p-unc = 0.011 and BF10 = 348.375 means, there is decisive evidence for H1 (significant difference). In Moderate – Very High socioeconomic status component for learning strategy (ER), p-unc = 0.01 and BF10 = 128.047 means, there is decisive evidence for H1 (significant evidence). In High – Very High, the socioeconomic status for learning strategy (ER) has p-unc = 0.01 and BF10 = 6.488 means, there is substantial evidence for H1 (significant difference).

Table 17: Pairwise *t*-test results for socioeconomic status on learning strategy - Peer learning
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POST HOC TESTS - PL
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	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
PL	SES	Low	Moderate	FALSE	TRUE	-1.830	252	two-tail	0.068	0.588	-0.195
PL	SES	Low	High	FALSE	TRUE	-0.768	16	two-tail	0.454	0.342	-0.192
PL	SES	Low	Very High	FALSE	TRUE	-3.993	4	two-tail	0.014	188.557	-1.395
PL	SES	Moderate	High	FALSE	TRUE	0.014	18	two-tail	0.989	0.275	0.004
PL	SES	Moderate	Very High	FALSE	TRUE	-3.378	5	two-tail	0.023	26.567	-1.201
PL	SES	High	Very High	FALSE	TRUE	-2.858	8	two-tail	0.020	4.857	-1.274

In table 17, the Low – Very High socioeconomic status component for learning strategy (PL) has p-unc = 0.014 and BF10 = 188.557 means, there is decisive evidence for H1 (significant difference). In Moderate – Very High socioeconomic status component for learning strategy (PL), p-unc = 0.023 and BF10 = 26.567 means, there is strong evidence for H1 (significant evidence). In High – Very High, the socioeconomic status for learning strategy (PL) has p-unc = 0.01 and BF10 = 4.857 means, there is substantial evidence for H1 (significant difference).

Table 18: Pairwise t-test results for socioeconomic status on learning strategy- Help seeking
POST HOC TESTS - HS

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
HS	SES	Low	Moderate	FALSE	TRUE	-1.236	247	two-tail	0.217	0.246	-0.133
HS	SES	Low	High	FALSE	TRUE	-0.525	15	two-tail	0.607	0.301	-0.157
HS	SES	Low	Very High	FALSE	TRUE	-10.081	6	two-tail	0.000	8.72x1016	1.349
HS	SES	Moderate	High	FALSE	TRUE	-0.079	17	two-tail	0.938	0.275	-0.023
HS	SES	Moderate	Very High	FALSE	TRUE	-8.132	10	two-tail	0.000	1.017x1010	-1.198
HS	SES	High	Very High	FALSE	TRUE	-3.726	17	two-tail	0.002	19.8	-1.118

In table 18, the Low -Very High socioeconomic status component for learning strategy (HS) has p-unc = 0.000 and BF10 = 8.72x1016 means, there is decisive evidence for H1 (significant difference). In Moderate – Very High socioeconomic status component for learning strategy (RE), p-unc = 0.000 and BF10 = 1.017x1010 means, there is decisive evidence for H1 (significant evidence). In High –Very High, the socioeconomic status for learning strategy (METS) has p-unc = 0.002 and BF10 =19.8 means, there is strong evidence for H1 (significant difference).

Table 19: Pairwise t-test results for socioeconomic status on academic achievement
POST HOC TESTS - Achievement

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
ACA	SES	Low	Moderate	FALSE	TRUE	0.482	274	two-tail	0.630	0.132	0.050
ACA	SES	Low	High	FALSE	TRUE	-1.22	16	two-tail	0.241	0.497	-315
ACA	SES	Low	Very High	FALSE	TRUE	-0.038	4	two-tail	0.972	0.400	-0.011
ACA	SES	Moderate	High	FALSE	TRUE	-1.379	17	two-tail	0.186	0.601	-0.394
ACA	SES	Moderate	Very High	FALSE	TRUE	-0.194	5	two-tail	0.854	0.408	-0.066
ACA	SES	High	Very High	FALSE	TRUE	0.78	10	two-tail	0.453	0.533	0.318

In table 19, the pairwise t-test results were presented in which the p-unc (Uncorrelated p-values) for the socioeconomic status (Low – Moderate, Low – High, Low – Very High, Moderate – High, Moderate – Very High and High – Very High) are not statistically significant (i.e p-unc all above .05) which indicate statistically significant difference in students' academic achievement based on the socioeconomic status in chemistry. The BF10 = 0.601 (i.e Moderate and High) means, that the data is 0.6 as likely to have occurred under the H1 (significant difference) than the H0 (no significant difference).

Table 20: Pairwise t-test results for socioeconomic status on metacognition in chemistry
POST HOC TESTS - Metacognition

	Contrast	A	B	Paired	Parametric	T	dof	Tail	p-unc	BF10	hedges
META	SES	Low	Moderate	FALSE	TRUE	-0.443	239	two-tail	0.658	0.130	-0.048
META	SES	Low	High	FALSE	TRUE	-0.537	15	two-tail	0.599	0.302	-0.150
META	SES	Low	Very High	FALSE	TRUE	-4.840	5	two-tail	0.006	4295.755	-1.056
META	SES	Moderate	High	FALSE	TRUE	-0.351	17	two-tail	0.730	0.289	-0.095
META	SES	Moderate	Very High	FALSE	TRUE	-4.385	6	two-tail	0.005	554.913	-0.952
META	SES	High	Very High	FALSE	TRUE	-2.609	16	two-tail	0.019	3.372	-0.894

In table 20, it was observed that Low – Very High socioeconomic status component for students' metacognition (META) in chemistry has p-unc = 0.006 and BF10 = 4295.755 means, there is decisive evidence for H1 (significant evidence) since the BF > 100. Also, the Moderate – Very High socioeconomic status component for students' metacognition in chemistry has p-unc = 0.005 and BF10 = 554.913 means, there is decisive evidence for H1 (significant difference) since the BF > 100.

Discussion of Findings

This study findings show that there is a significant positive correlation between students learning strategies use and academic achievement but the strength of the correlation is weak. The results also show that help-seeking strategy has the strongest correlation while effort regulation has less correlation with students' academic achievement. This result corroborates the previous studies by Chan Lin (2012) that found that the relationship between effort regulation and academic performance is not significant. Hamid and Singaram (2016) also, noted in their research that learning strategies: critical thinking and time, and study environment were significantly poorly correlated to academic performance of medical students. In contrast, some studies found that effort regulation is important in facilitating academic performance (Kassab et al., 2015; Komarraju and Nadler, 2013).

The result of standardized regression weights shows that the factor loading for students' learning strategies use and students' metacognition is high (i.e > 0.7), this means that there is a significant positive correlation between students' learning strategies use and students' metacognition and the correlation is high. Finding shows there is statistically significant difference in students' learning strategies use based on their socioeconomic status.

Finding from this study shows there is statistically significant difference in students' academic achievement in chemistry based on their socioeconomic status. This corroborates the findings of Karnel (2001) and Teese (2004) that shows there is statistically significant difference in students' academic achievement based on their socioeconomic status. Brodie (2001), and Lloyd (2002) also showed a positive relationship between socioeconomic status and academic achievement of students.
Finding also shows there is statistically significant difference in students metacognition based on their socioeconomic status.

Conclusion

This study was conducted on 421 SS2 Chemistry students within 12-week of a school session. It involves a combined instrument of LSS, MLI-C and CAT. The instruments were completed at three intervals during the study; pre, post and delayed post except CAT that was administered twice, (pre and post). From the results, learning strategies use have positive impact on students' academic achievement and metacognition in chemistry. Learning strategies use have high correlation with metacognition but low correlation with achievement. It was concluded that if learning strategies intervention using POCILSIM is included in our education program at all levels, it will improve the students' academic achievement and metacognition which will directly improve the standard and quality of the country's work force and economy.

Recommendations

1. In order to assist the students to improve on their metacognition, teachers should teach the students how to self-regulate by integrating the various learning strategies in their teaching strategies
2. Curriculum developers should design materials on shaping instructional delivery and support programs to foster students' success, increase retention, improve students' metacognitive skills and instil learning strategies culture in the students
3. Policy makers should approve the inclusion and teaching of learning strategies using POCILSIM at all levels in the National curriculum.

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